Arab American University-Jenin

Faculty of Graduate Studies

"Impact of Picture Archiving and Communication System (PACS) on Emergency Departments in Palestinian Governmental Hospitals"

By

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Approval form

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This thesis was defended successfully on 15-02-2022 and approved by:

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Declaration

I hereby declare that this thesis represents my own work, otherwise referenced, and has not been previously included in a thesis or dissertation submitted elsewhere for a degree, diploma or other qualifications.

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Date: 22.02.2022

Dedication

I dedicate this project to God Almighty my creator

My strong pillar, my source of inspiration, wisdom, knowledge and understanding

My Family

They have been the source of my strength throughout this program

My lovely wife

For her endless patience and support and my source of encouragement

My sweet and adorable children

My friends and everyone who helped me and believed in me

To martyrs and detainees

To my people

Acknowledgement

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I would also like to extend my special thanks and gratitude to my mother and my father, my source of inspiration for their continuous support, also to my family members.

My heartfelt gratitude to my wife and children, who have endured years of missed free time as a result of my absence, as well as the increased workload that has resulted.

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Finally, I want to express my gratitude to the personnel of the Health Informatics program as well as the entire AAUP for allowing me to do this research. And I must appreciate the Palestinian Ministry of Health and the hospital employees who completed the questionnaires.

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Abstract

Introduction

PACS has been recently adopted in governmental hospitals in Palestine. PACS is considered one of the most important new healthcare technologies that improve patient health care, allowing medical images to be stored, retrieved, transmitted, and displayed in a hospital or health system's many sites.

In Arab countries, there is very small number of studies and in Palestine it’s the first study that measures the acceptance level of PACS. By using technology acceptance model TAM, the impact of PACS in emergency departments in governmental hospitals user's acceptance level of PACS is investigated. Even the best and most expensive IT system will be rendered ineffective if its users resist it, so the user's acceptance is important to the success of PACS implementations in healthcare organizations.

Purpose of the study

The purpose of this study is to evaluate the impact of picture archiving and communication system (PACS) on emergency departments in Palestinian governmental hospitals.

Methods of the study

The study was descriptive cross-sectional design. Twelve governmental hospitals in Palestine were included in the study. All physicians who work in emergency departments participated in the study (160 physicians). The study is quantitative and surveyed user’s

(physicians) perceptions, attitudes, and behaviors toward using PACS by using a questionnaire**.** Data were analyzed using the IBM Statistical Package for Social Sciences (SPSS) version 20**.**

One hundred and thirty five out of 160 questionnaires were completed and returned to the researcher (response rate 84.37%). The results revealed that using PACS has made physicians job easier to perform (mean=4.20). Using PACS enables to accomplish tasks more quickly (mean=4.19). PACS has improved the quality of work in providing better patient care (mean=4.19). Learning to use the PACS has been easy (mean=4.10). PACS made the physicians practice less stressful, easy, pleasant and interesting, it recommends using PACS to other emergency departments (mean=4.39). In addition, descriptive statistics showed that overall acceptance level was of a Moderate degree with mean (3.11). Correlation analysis showed that there is positive statistically significance between PU, PEU, Change as total score and Acceptance. Multiple regressions showed that the highest influencing factor was change factor. ANOVA test showed that no impact on the overall acceptance from socio-demographic variables.

TAM model was used to evaluate the impact of PACS on emergency departments and to measure the user's acceptance for this system. User's acceptance is an important factor in the success of healthcare IT adoption and implementation.

As a result, PACS is recommended system from the point of view of emergency physicians. The overall acceptance level was of a Moderate degree, change factor was the highest influencing factor, PACS made the physicians practice less stressful, easy, pleasant

and interesting, and they considered it easy to use the system which improves the quality of their work leading to better patient care.

Finally, the impact of PACS on emergency departments work practice is positive effect and it improves patient health care in general.

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List of Abbreviations

AAUP: Arab American University of Palestine

ANOVA: Analysis of Variance

CR: Computed Radiography

CT: Computed Tomography

DICOM: Digital Imaging Communications in Medicine

DR: Digital Radiography

EHR: Electronic Health Record

HIS: Hospital Information System

EMR: Electronic Medical Record

IP: Internet Protocol

IT: Information Technology

MOH: Ministry of Health

MRI: Magnetic Resonance Imaging

NEMA: National Electrical Manufacturers Association

PACS: Picture Archiving and Communication System

PDA: Personal Digital Assistant

PEU: Perceived Ease of Use

PU: Perceived Usefulness

RIS: Radiology Information System

SPSS: Statistical Package of Social Science

TAM: Technology Acceptance Model

TCP/IP: Transmission Control Protocol/Internet Protocol

TRA: Theory of Reasoned Action

US: Ultrasound

UTAUT: Unified Theory of Acceptance and Use of Technology's

CHAPTER ONE

INTRODUCTION

1.1 Background

Healthcare sector should always be up to date, adopt and use new methods and technologies in order to improve patient's health and provide maximum quality of health services that keep the community health status at a high level.

Using modern technologies to improve the quality and efficiency of the healthcare system has become increasingly important, and it is both necessary and inevitable in light of the rapid changes in the environment and the need for flexibility (Bahador et al., 2016; Goodarzi et al., 2016).

The revolution in information and communication technology has had profound effects on all aspects of the economy, society, politics, and global security (Robertson & Saveraid, 2008). The health system is one of the most important fields of information technology application (Bahador et al., 2016). Since the introduction of the Picture Archiving and Communication System (PACS) in the early 1980s, it has seen significant changes in radiology practice (Mansoori et al., 2012; Faggioni et al., 2011). Information technologies should be effectively utilized to make the best decisions and to generate knowledge that can be applied to the field of health (Bahador et al., 2016). Radiography is an activity that is highly structured, complex, distributed, technological, production-oriented, and image-

centered (Larsson et al., 2007; Armbrust, 2009). PACS is considered one of the most important examples of information and communication technologies that have been adopted, allowing medical images to be stored, retrieved, transmitted, and displayed in a hospital or health system's many sites (Goodarzi et al., 2016; Bahador et al., 2016; B. Aldosari, 2012; et al., 2020).

Digital images can be saved in a database and retrieved using a file management server, transported across computer networks, displayed at various resolutions to users with varying needs, and analyzed and processed as a reference for medical treatment utilizing such a system. The integration of a PACS as a module into a larger Radiology Information System (RIS) or Hospital Information System (HIS) is now commonplace (B. Aldosari, 2012; Blackwell, 2008).

All who had implemented PACS into the health sector saw the benefits of full deployment of a trust-wide PACS in terms of patient management, reporting efficiencies, and overall organizational gains (Sutton, 2011). Using PACS in hospitals has a slew of advantages on multiple levels (Vest et al., 2015; Buabbas et al., 2016).

PACS system used by many health care providers includes medical imaging technologists, radiologists, physicians, nurses and image library personnel. The palpable advantages of a PACS are well-known and many, and include the following: improving the medical image service's organizational performance; allowing images to be retrieved at any time and from any location; reducing image retrieval and medical report turn - around time; adding scans to patients' electronic health records (EHR); more efficiently organizing the use of diagnostic devices; enhancing long-distance consultations. Impalpable benefits

include higher satisfaction among radiology personnel and referring physicians with the service, as well as increasing patient satisfaction with their treatments (B. Aldosari, 2012; Ayal & Seidman, 2009).

Unfortunately there is small number of studies of PACS acceptance compared with the increasing, widespread, and use of the system in the world (B. Aldosari, 2012) . In Arab country a very small number of studies and in Palestine it's the first study that measure the acceptance level of PACS. In the current study, the researcher used technology acceptance model TAM to investigate the impact of PACS in emergency departments in governmental hospitals and measuring the user's acceptance level of PACS. It's very important to measure the user's acceptance of the system, PACS as one of IT system will make change in work practice and work flow and it will be challenging to adopt and implementation. Even the best and most expensive IT system will be rendered ineffective if its users resist it, it is apparent that user acceptance is critical to the success of PACS implementations in healthcare organizations (B. Aldosari, 2012) .

The technology acceptance model (TAM) was derived from the Theory of Reasoned Action (TRA) in its original form (B. Aldosari, 2012; Goodarzi et al., 2016). The TAM is a description of how users accept and use technology. Developed by Davis (Davis, 2015), two acceptance measures are the primary determinants of behavioral intention to use technology, according to the model.: (1) Perceived usefulness (PU), defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance";* and (2) Perceived ease of use (PEU), defined as *"the degree to which a person believes that using a particular system would be free from effort"* (Davis, 2015).

1.2 Statement of the problem

These days, technological improvement is one of the important things in life matters, especially in the matter of health. Medical imaging is one of the most important diagnostic methods of diseases, therefore it is necessary to be up to date, and the picture archiving and communication system PACS is one of the most important technologies used in medical imaging that must be developed and adopted because of its important role and advantages for patient's health. It is necessary to measure the acceptance level of the new system admitted to the health care sector and to investigate its impact on the work practice that is affected by the system to ensure success of system implementation.

In Palestine, PACS is recently adopted in governmental hospitals. Therefore studying the impact of PACS and its user's acceptance level can improve the physician's work practice with PACS in emergency departments and improve health status.

There are still no studies about this field in Palestine, so this study is very important and it will contribute with improving Palestinian healthcare system.

1.3 Study objectives

The main objective:

The purpose of this study is to evaluate the impact of PACS on emergency department work practice of Palestinian governmental hospitals and user's acceptance level

of PACS from the point of view of the emergency physicians, by using the technology acceptance model (TAM).

Secondary objectives:

1. To improve the use of PACS by healthcare staff and maximize the usefulness of this system to improve overall public and community health status.

2. Examine the impact of socio-demographic factors on the extent to which the PACS system affects the services delivered.

1.4 Research questions

1. What is the user's acceptance level of PACS in emergency departments in governmental Palestinian hospitals?

2. What is the relationship between (PU, PEU, Change) and Behavior (user's acceptance) of PACS in emergency departments in governmental Palestinian hospitals?

3. Which factor from TAM has the highest impact on user acceptance of PACS?

4. What is the impact of socio-demographic variables on the users' acceptance level?

5. Is PACS considered a useful system and can it improve patient care from user's point of view?

6. To what extent does the PACS change the user's practice?

7. Is PACS considered easy to use system? And is it recommended?

1.5 Significance of the study

This study will be the first investigate and explore the impact of PACS system and the user's acceptance level from the point of view of emergency physicians in emergency departments in governmental Palestinian hospitals. Given the global relevance of this system, and the fact that it is being implemented for the first time in Palestine, it will serve as a form of evaluation for the use of PACS and its role in the improving healthcare system in Palestine. By this study, the usefulness of PACS and healthcare services can be improved. It will be a good assessment for this system.

In addition, this study is considered as the first study in Arab countries that use TAM model to measure the user's acceptance level and impact of PACS in the emergency departments from the physicians' point of view.

1.6 Outline Structure of the thesis

The arrangement of the thesis appears as the following:

-Chapter one includes a general introduction about the study, a problem statement, study objectives, research questions and significance of the study.

-Chapter two includes a theory and literature review about PACS, Digital Imaging Communications in Medicine (DICOM), Hospital Information System (HIS), Radiology Information System (RIS), Electronic Medical Record (EMR), Implementation and Challenging of PACS, Overview of PACS in Palestine, universal and regional studies of PACS and Technology Acceptance Model TAM. The researcher outlined the most important and relevant publications on the subject, highlighted their main points, discussed knowledge gap, and assessed the publication's contributions to the issue.

-Chapter three where the research methodology is presented, including study design, study setting, study population and sample size, study instrument, reliability of the questionnaire, data collection, data analysis, scale correction and ethical considerations.

-Chapter four where the results are shown, this chapter contains information about the respondents, as well as tables of percentages linked to questionnaire data and research that back up the study's findings.

-Chapter five in which discussion, the conclusion, recommendations, strength of the study and future work, are presented.

CHAPTER TWO

LITERATURE REVIEW AND THEORY

2.1 Introduction

The study assessed the "Impact of Picture Archiving and Communication System (PACS) on Emergency Departments in Palestinian Governmental Hospitals". The chapter includes a literature review and PACS theory referring to the variables of study. Published studies in PubMed, Google Scholar and textbooks were investigated in this study as a search strategy. For this study, literature review involved a comprehensive search with key words: Picture archiving and communication system, Digital imaging _ Digital imaging communications in medicine, Radiology information system, challenging and implementations of PACS, success of PACS, technology acceptance model (TAM), comparison between PACS and conventional imaging system.

This chapter includes subsections about Picture Archiving and Communication System (PACS), Implementation and challenging of PACS, Overview of PACS in Palestine, universal, and Regional studies about PACS.

2.2 Theory

2.2.1 Picture Archiving and Communication System (PACS):

PACS is a technology that allows for the viewing, manipulation, archiving, and sharing (communication) of digital medical images (Bontrager & Lampignano, 2014). PACS includes the hardware and software both of them are needed for image importation into the PACS, viewing, storage, annotation and, communication/transmission functions. Diagnostic images are paired with other related data such as patient profiles, clinical history, and medical reports in the PACS (Top, 2012; Armbrust, 2009).

Connections to medical imaging modalities (Computed Radiography (CR), Digital Radiography (DR), Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound (US), etc.), server, imaging workstations, network lines, and storage systems are among the hardware components (Toms et al., 2006).

Database and workflow management, as well as image viewing and manipulation, are all included in the software components (Robertson & Saveraid, 2008). The PACS allows for archival, storage, and transmission of data to various viewing stations within the hospital through a local area network from a database/workflow management perspective (Top, 2012; Bontrager & Lampignano, 2014). It is also possible to link to the internet for image interpretation (teleradiology), storage, or web browsing (Bontrager & Lampignano, 2014).

Manipulation of images, with computed radiography and digital radiography, the radiation dose is reduced. Reduction in the number of repeat radiographs, Image

availability is immediate. Comparison of previous image availability there is no missing images. Images are visible in a variety of locations at the same time. Improvements in the productivity of the medical staff, Reports with images are available (Top, 2012).

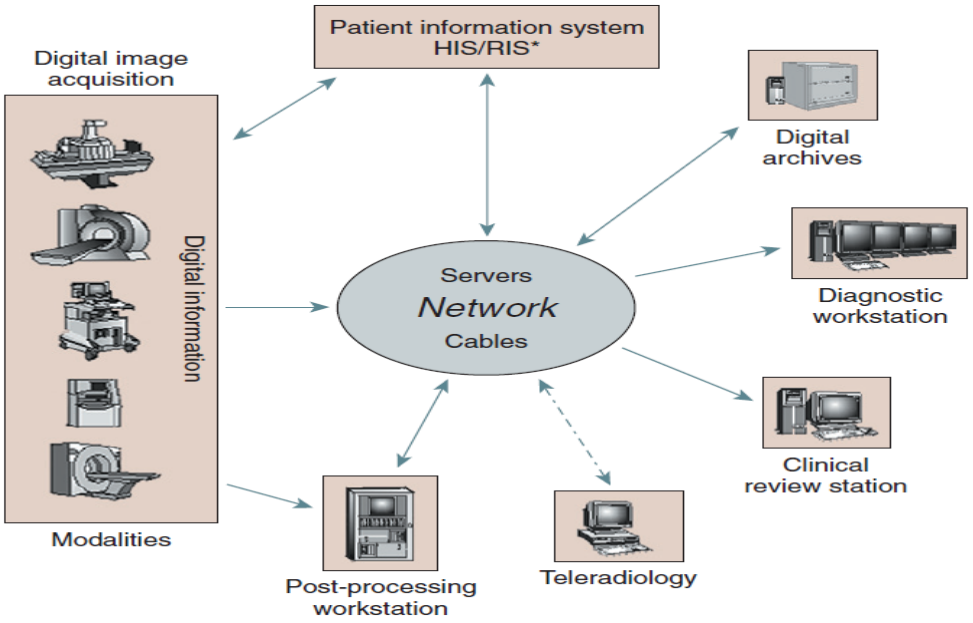

Figure 2- 1 Full PACS Network Components

Fig 2-1 above describes the entire PACS Network Components, includes digital acquisition, communication, reporting, and archiving. *HIS/RIS, hospital information system/radiology information system.(Bontrager & Lampignano, 2014)

The image display capabilities and features of PACS software differ. Zooming, contrast and brightness (window width and window leveling) changes, annotations and

marking, and measuring functions are all features of image viewing software that can be used on imaging workstations (Armbrust, 2009).

The following parameters will help understand the communication between the PACS and the medical imaging modalities: The assigned communication port, the Internet Protocol (IP) address, and the Application Entity Title (AE title). Each computer's IP address is unique and is used to identify it on the network. The AE title is also special and refers to a computer program. The port is the specific device entry and exit point through which image data is permitted to pass. Another word you might come across is TCP/IP (Transmission Control Protocol/Internet Protocol) (Armbrust, 2009).

TCP/IP is a network communication protocol that allows computers linked to the Internet to communicate with one another. It is considered the industry norm for network communication. All of these parameters must be set before the actual connections can be made. However, a fast network with modern switches would allow for faster image transmission and less data transfer errors (Armbrust, 2009; Robertson & Saveraid, 2008).

2.2.2 Digital imaging communications in medicine (DICOM)

DICOM is a special image file format is similar to the JPEG and tagged image file formats that are widely used in the editing and storage of digital images captured. DICOM was created in the early 1980s to enable medical imaging equipment from different vendors (CT, MRI, ultrasound, nuclear medicine, and digital radiography) to communicate with multiple displays and archiving systems (Robertson & Saveraid, 2008; Wright et al., 2008).

After recognizing the need for integration between imaging equipment and software, the National Electrical Manufacturers Association (NEMA) and the American College of Radiology created DICOM (Armbrust, 2009). This interconnection necessitates the use of a common format for all medical images. In other words, software from vendor C should be able to view the cassette-based digital radiography system from the vendor A and the cassette-less digital radiography system from vendor (Bontrager & Lampignano, 2014; Robertson & Saveraid, 2008).

DICOM 3.0 was first published in 1993, and since then, it has received several updates and supplements, almost on a monthly basis, to address new technologies (Toms et al., 2006). It is now widely accepted as the international standard of human medicine, and all imaging vendors should follow it. In veterinary medicine, there is currently no requirement for DICOM conformance, but it is strongly recommended that all programs have a DICOM conformance statement (Toms et al., 2006; Robertson & Saveraid, 2008).

The conformance statements can be very long and difficult to assess. The image is essentially the DICOM entity. DICOM service classes are divided into service class users and service class providers, and each has a different function (Robertson & Saveraid, 2008). When sending an image from an imaging modality to a PACS server, for example, the digital radiography device is the consumer and the PACS server is the provider (Armbrust, 2009; Shakeshaft, 2010).

2.2.3 Hospital information system (HIS), radiology information system (RIS) and electronic medical record (EMR)

The radiology information system (RIS) or the hospital information system (HIS) should be integrated with PACS for optimal performance (Bontrager & Lampignano, 2014; Robertson & Saveraid, 2008).The HIS or RIS communicates with the modality through a worklist, which automates the entry of patient demographic information for each test. Additionally, the need for hard copy images can arise, and the DICOM print service class provides a method for printing images on translucent film accurately (Robertson & Saveraid, 2008).

From hospital billing to the inpatient ordering system and planning and patient care, the HIS stores all patient's medical records (Bontrager & Lampignano, 2014; Moghaddasi et al., 2018). From patient scheduling information to the radiologist's dictated and transcribed study, the RIS stores all radiology-specific patient details. The EMR is either part of the HIS or runs alongside it, and it includes all of the patient's information, including test results, radiology reports, pathology results, and notes from nurses and doctors. Most ancillary service systems are interfaced with the EMR to retrieve reports so that they can be displayed in this one standard format.

2.2.4 Implementation and challenging of PACS

One of the most important advantages of introducing a PACS is that it can provide multiple concurrent accesses to images, while in traditional (film) imaging only a single collection of films can be accessed at a single venue. The time needed to handle the film file room is reduced by a PACS, but time is still required to manage the computer system and workflow issues (Armbrust, 2009). Also using PACS improved the accuracy of physicians reading of radiographs (Hurlen et al., 2017; Xue et al., 2016).

PACS has also resulted in a slew of well-documented advantages, including increased medical image system operational reliability and effectiveness, cost savings, reduced imaging retrieval wait times and clinical report turnaround times, and more efficient use of radiology devices (Goodarzi et al., 2016; Hurlen & Borthne, 2010; Song et al., 2017).

Many of the above advantages would have a major impact on areas like emergency medicine. Rapid diagnosis is critical in emergency medicine, so using PACS in the emergency room would increase quality and patient safety in the long run (Goodarzi et al., 2016; Gouin et al., 2006). The previous study has backed up and highlighted the advantages of using PACS in the emergency department.

Despite the many advantages of using PACS, there are several challenges and difficulties in implementing and using this technology. PACS is unique in that it is complex by default, necessitates a significant capital investment, and involves integration with other instruments to process data from different hospital information applications in order to optimize its efficiency (Chang et al., 2006; Alhajeri & Shah, 2019).

Training issues, a lack of support, system failures, recurrent downtime, difficulty able to access images, the need to change the work flow, cost, and users' resistance to accept the technology are the most widely mentioned challenges in the literature (Alalawi et al., 2016; Khajouei et al., 2019).

Making the switch to digital imaging isn't easy. Training is required for users to gain new skills and improve the work flow process (Alalawi et al., 2016). Denial of technology is a significant obstacle that leads to the failure of even the best and most costly information technologies. As a result, using technology like PACS to fix various aspects of this problem is critical (Goodarzi et al., 2016; Chang et al., 2006).

Saghafi, 2017 and Chang et al., 2006 mentioned that the Adoption and implementation of PACS were influenced by a number of critical success factors. Ability to make decisions about which PACS to buy and how to buy it This ability is enhanced by collaborating physicians, nurses, and radiology personnel. However, selecting a high-quality system with the least amount of downtime is important, also access to a stable network with adequate bandwidth for hospitals, on the one hand, and compatibility and alignment of PACS with current hospital information systems, on the other, and is both parts of the required infrastructure that allows hospital administrators to incorporate this system more enthusiastically. PACS pilot implementation, high-level manager support, government policy, and planned PACS benefits were also critical success factors (Saghafi, 2017; Chang et al., 2006).

2.3 literature review

2.3.1 Overview of PACS in Palestine

Technological development is spreading rapidly in the world as well as in Palestine, and this has great benefits for societies, especially the development in the health sector. In Palestine, the health system in government hospitals in the West Bank began to be converted from a paper system to an electronic system nearly ten years ago. This development is considered as an infrastructure for subsequent developments, as the Picture Archiving and Communication System (PACS) was introduced and implemented after a period of conversion (2018).

The PACS system was gradually implemented in governmental hospitals in the West Bank over more than one stage, ending with its implementation in twelve governmental hospitals out of sixteen hospitals. STRADUS HYBRID RIS PACS system was adopted in these hospitals.

2.3.2 Universal study about PACS

A study for (Duyck et al., 2008) was conducted in Belgium aimed to gain insight into the individual user acceptance of PACS by the radiology department staff of the Ghent University Hospital. In this research, they included both radiologists and technologists who

worked in the radiology department. The findings showed that the adoption of new technology in a hospital environment is dependent on the technology's value for the job in general, as well as the assistance that can be given in the event of any problems. It has also been demonstrated that radiologists have a better understanding of PACS as a whole than technologists, especially when it comes to the benefits of PACS. This is self-evident. since physicians are expected to keep up with modern methods and technologies (Duyck et al., 2008).

Another study was conducted in the United Kingdom titled "Picture archiving and communication systems: A multicentre survey of users experience and satisfaction". The aim of this study was to determine how users felt about picture archiving and communication systems (PACS). They concluded that clinicians generally support PACS systems, but that there are some areas that need to be addressed, such as training, monitoring quality, and reliability. They recommended the following for those looking to incorporate a PACS framework as a result of this survey:

1. All users should be given the opportunity to undergo training, and all users should be given the time to do so.

2. PACS images used for diagnostic purposes should be viewed on diagnostic-quality monitors in appropriate lighting.

3. Monitors should be accessible in all clinical environments, including clinic rooms and conference rooms, to allow for easy discussion of images (Ling & Lewis, 2010).

Moreover, an observational study over a period of 4 weeks from 15 January 2010 to 15 February 2010 was carried out in Pravara Rural Hospital, loni, India. The aim of the study was to compare traditional imaging with picture archiving and communication systems from the perspective of users, as well as the effect of PACS on patient care and education. According to the findings, 85 percent of users considered PACS to be very easy to use. PACS was viewed as a valuable tool for the hospital by 94% of users. Image quality at the image analysis workstation was rated as outstanding by 51% of users, and the availability of radiological reports alongside images was rated as very useful by 73 percent. Sixty-one percent said their time spent identifying images for analysis had decreased significantly. Sixty three percent showed a substantial reduction in the amount of time they spent searching for radiological reports. The availability of PACS has prompted a big shift in the way rounds are taken, according to 58% of users. PACS, according to 75% of users, made ward rounds more effective. Seventy nine percent said yes, PACS is easier to use than conventional film-based systems. According to 51% of users, PACS is also a strong teaching tool. The availability of PACS in a tertiary care hospital and medical college, according to the study, is a move toward filmless imaging (Jorwekar et al., 2015).

In addition, a study for (Top, 2012) conducted to determine the physicians' views and assessments on PACS in two public hospitals in Turkey was descriptive based on a questionnaire survey that has shown that the majority of physicians consider PACS to be a significant advancement for their hospitals, with less dissatisfaction than using film, better image quality, and an increase in their working lives and patient care. They mentioned that

PACS provided them with radiology reports in a timely manner. PACS was also thought to have boosted physician consultations.

The findings of the physician analyses of the advantages and drawbacks of PACS in their hospitals indicated that the benefits of PACS outweighed the drawbacks by a wide margin. PACS has been well received by a large number of hospital physicians. Since PACS changes over time and components are periodically replaced, users can expect to hear about new updates and enhanced features on a regular basis. The PACS clearly leads to an improvement in the effectiveness of health care practitioners and physicians (Top, 2012).

Also, the acceptance level of PACS in the emergency departments of three educational hospitals in Iran was measured using a version of the technology acceptance model (TAM). The study aimed to predict factors affecting acceptance score as the dependent variable, a stepwise multiple regression model was used. They measured and evaluated user acceptance of PACS in three separate hospitals' emergency departments, as well as the impact of socio-demographic factors on this acceptance. They come to the conclusion that PACS is well-liked in all three hospitals, especially among specialists. The acceptance is influenced by all three factors: PU, PEU, and change. Change, which involves factors influencing the practice situation, had the greatest impact. They recommended more research to discover other factors that influence PACS acceptance or to compare the levels of acceptance in different wards (Goodarzi et al., 2016).

Another study for (Abbasi et al., 2020) was conducted in Kerman in 2017 at three major university hospitals. They included all of the available senior residents (n = 59) who have used PACS. The researchers used a self-administered questionnaire to determine the level of user satisfaction with PACS and to compare its functional features with conventional film-based systems to achieve the study goal.

According to the study's findings, despite the fact that physicians' satisfaction with PACS ranged from moderate to high, there are still issues with effectively implementing the system and ensuring interoperability between it and other treatment centers. The findings revealed that in some healthcare facilities, PACS has not completely met all of the demands of physicians and has not met its predetermined goals, such as all-access from multiple locations. To address some of the issues, the findings recommended expanding the number of workstations for these systems or using a personal digital assistant (PDA) to minimize the time it takes to get to a station and to promote providing treatment at the patient's bedside, as well as user-specific training for more stable system implementation. Adding a printing option to the system may also be useful for sending images to locations outside of the hospital (Abbasi et al., 2020).

Furthermore, Between June 2004 and December 2005, a study was conducted at ten hospitals in the Thames Valley area of southwestern Ontario, Canada. They used administrative claims data from the Ontario Health Insurance Plan to see whether the implementation of PACS decreased the frequency of repeat imaging tests. They considered PACS to have been fully implemented when a hospital officially began "filmless"

operations. The primary outcome indicator was the change in the frequency of duplicate imaging examinations after the implementation of PACS.

The imaging modalities included in this study were: abdominal X-ray and chest; computed tomography of the head, abdomen, pelvis, and chest. The frequency of duplicate testing was investigated over three time periods: seven days, thirty days, and sixty days after an index test.

The study found that the overall frequency of duplicate imaging examinations is low. And that there were no significant absolute reductions in the frequency of duplicate imaging examinations after PACS was implemented. Electronic medical systems should be tested separately to confirm commonly held assumptions about their possible benefits (You et al., 2008).

Another cross-sectional study was conducted in a teaching hospital affiliated with Tehran University of Medical Science (TUMS) from February to June 2016. The population in this study was all physicians who worked in TUMS-affiliated hospitals. A questionnaire was created as a data collection method, and physicians' perceptions of PACS adoption were measured using the Unified Theory of Acceptance and Use of Technology's conceptual path model (UTAUT).

Performance expectancy, effort expectancy, social influences, and behavior intention all have a clear and important impact on PACS adoption, according to the results, which provided useful insights. The condition of the facility, on the other hand, had little effect on physicians' conduct intentions.

The study concluded that the adoption of emerging technologies in the healthcare sector, such as PACS, is inevitable. The effective usage of PACS alters the process for accessing digital images, resulting in shorter processing times, less tests and exams, and higher patient throughput. End users' attitudes toward using and implementing PACS must be understood in order to achieve comprehensive interoperability and understand the advantages of this system. The experience of users is a critical factor in optimizing PACS implementation, and healthcare managers and policymakers should take this into account.

PE, EE, SI, and behavior intention are all determinant variables that may influence physicians' behavior intention toward the adoption of PACS. Furthermore, the findings revealed that Facility Conditions have no immediate or substantial impact on physicians' conduct intentions. They suggested that future research focusing on creating a standard for PACS adoption by other healthcare personnel, such as nurses and radiologists, as well as evaluating PACS adoption using a different model, such as TAM or TPB (Salih, n.d.).

Moreover, in 2016, an analytical and cross-sectional study was carried out at five military hospitals in Tehran used PACS to complete their tasks. They used the unified theory of acceptance and technology used to identify factors that affected the acceptance of PACS by the users they researched. Performance expectancy, social effect, facilitating conditions, effort expectancy, and behavioural intention were all factors considered. This study looked into the factors that influenced healthcare workers' acceptance of PACS technology in Tehran's military hospitals. The findings revealed that, in terms of behavioural intention to use their PACS, performance expectancy and facilitating conditions had the strongest and weakest relationships, respectively. Performance

expectancy has a substantial impact on a user's behavioural intention, according to the study.

Behavioural intention among hospital healthcare workers is significantly influenced by social influence and facilitating conditions. The multiple linear regression analysis, on the other hand, results revealed that only performance expectancy has the ability to predict behavioural intention, and had an impact on the decision to use PACS and should be taken into account by medical center managers in order to effectively implement PACS. It appears that PACS training is needed for healthcare staff. They suggested that more research be done using structural equation models and technology acceptance models to assess the acceptability of using healthcare technology systems like PACS (Ahmadi et al., 2017).

2.3.3 Regional studies about PACS

A study conducted at Mubarak Al-Kabeer Teaching Hospital, one of Kuwait's five regional hospitals, the aim of this study was to evaluate the success of the PACS in clinical practice in order to ascertain the technology's merits for radiologists and technologists, as well as its disadvantages. Quantitative and qualitative techniques were used throughout the research, including questionnaires provided to all radiologists and technologists and interviews with PACS administrators.

They concluded that the PACS had a positive effect on the diagnostic radiology department's radiologists and technologists, greatly increasing their work performance and

productivity. As a result, the technology's effect was especially noticeable in terms of its ability to store and retrieve images easily, allowing users to complete their tasks quickly. In addition, the system made it simple to add an image to a report, allowing contact with another location to be completed with a single keystroke.

Furthermore, the study revealed that the key concern expressed by all users was frequent breakdowns at busy workstations during rush hours due to infrastructure deficiencies. In response to the increasing demand for teleradiology, mobile image viewer, and voice recognition features, both technologists and radiologists suggested the need for a more advanced PACS. PACS performance is evaluated not only in terms of technology, but also in terms of organizational and human factors that can limit full integration with HIS (Buabbas et al., 2016).

Alalawi et al., 2016 conducts a cross-sectional descriptive study for assessment for PACS in Saudi Arabia at three of ministry of health hospitals in Riyadh region, to assess the PACS/function.

To assess radiologists' and referring physicians' perceptions of the PACS's benefits and challenges after implementation, open-ended questions were given to them. Workloads, workflows, specialties, and PACS/HIS vendors varied between the three hospitals, two survey questionnaires for physicians and radiologists were created as study instruments. The study conclude that PACS was well-liked by physicians and radiologists due to its various advantages. Radiologists, on the other hand, had a higher understanding of the advantages of PACS than physicians. PACS has resulted in difficulties locating images,

recurrent downtime, and insufficient training, to name a few drawbacks (Alalawi et al., 2016).

Also, in a study conducted at King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia, a Technology Acceptance Model (TAM) was used to determine the level of acceptance of the host PACS by the radiology department staff. User attributes, perceived usefulness (PU), perceived ease of use (PEU), a change construct, and a behavior (acceptance) construct were all assessed using a questionnaire survey. The findings showed that perceived usefulness (PU), perceived ease of use (PEU), and user acceptance were all strong. While PU was by far the most important determinant, PEU and a change construct both had a major impact on radiology staff acceptance. The most significant aspect of the PU construct was that users felt the PACS increased the quality of their work by allowing them to provide better patient care. In terms of PEU, the vast lot of staff agreed that learning to use the PACS was easy, and that the system had made their work more enjoyable, pleasant, and less stressful. The deciding variables explained 41% of the variation in PACS acceptance at KAMC, implying that other factors besides those assessed are likely influencing acceptance (B. Aldosari, 2012).

Furthermore, cross-sectional quantitative study was conducted at the King Abdul-Aziz Medical City's National Guard health radiology department affairs in Riyadh, and the data were collected using a survey methodology. The target population included all participating PACS users in the radiology department. The questionnaire was created to investigate the impact of PACS on five interrelated variables: service outcomes, external

communication, personal hassles, personal intentions, and increased blame from the viewpoint of users.

They found that if the Picture Archiving and Communication System (PACS) is set up in hospital settings, it can be a useful tool, and that PACS users have a good view of the PACS, as well as its effect on them and their work routine. The results of this study included an initial evaluation of radiology department management techniques in terms of PACS's effect on users. The key goal was to assist them in maintaining user satisfaction and identifying positive aspects to improve PACS functionality in the future (H. Aldosari et al., 2018).

2.4 **Technology acceptance model (TAM)**

The technology acceptance model (TAM) was derived from the Theory of Reasoned Action (TRA) in its original form (Goodarzi et al., 2016; B. Aldosari, 2012). TAM is a description of how users accept and use technology (Figure 2-2). Developed by Davis (Davis, 1989), Two acceptance measures are the primary determinants of behavioral intention to use technology, according to the model.: (1) Perceived usefulness (PU), defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance";* and (2) Perceived ease of use (PEU), defined as *"the degree to which a person believes that using a particular system would be free from effort"* (Davis, 1989).

The model proposes that PEU has a causal effect on PU, and that each of these has an influence on the user's attitude towards use; both PU and attitude toward use influence behavioral intention (acceptance), which in turn influences usage (Goodarzi et al., 2016; B. Aldosari, 2012).

TAM2 was created by adding some additional PU and PEU drivers, such as theoretical constructs of social influence processes and cognitive instrumental processes, to the original TAM (Davis, 2015).

(Venkatesh et al., 2012) proposed a later extension of the TAM. Performance expectancy (equivalent to PU), effort expectancy (equivalent to PEU), social influence, and facilitating conditions are all direct determinants of behavioral intention (acceptance) in the Unified Theory of Acceptance and Use of Technology (UTAUT). Four moderating variables (experience, voluntariness, gender, and age) are included in the model, and have been found to be important in some studies of technology acceptance (Davis, 1989; B. Aldosari, 2012; Goodarzi et al., 2016; In & Care, 2011).

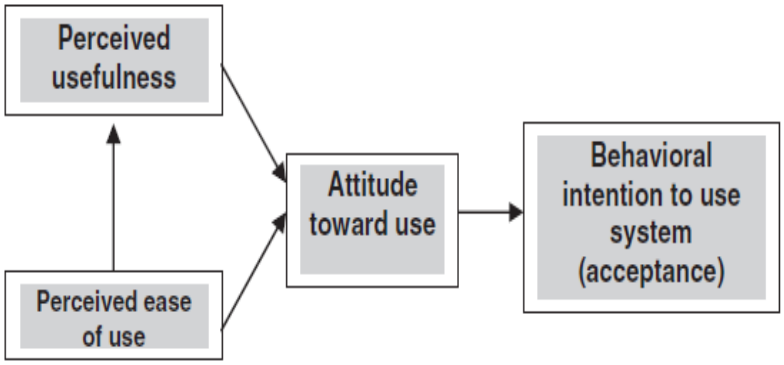

Figure 2- 2 The Technology Acceptance Model (TAM) of Davis

2.5 **Conceptual framework of the study**

The conceptual framework was adopted from modified TAM was derived from original technology acceptance model of Davis (Davis, 2015) and TAM 2 and UTAUT. The framework initiates the 4 main variables of (TAM) including (PU, PEU, Chang, Acceptance) and the relationships between them as shown in Fig (2-3).

The researcher used model that modified by researchers of previous studies differs from the original TAM they adding a change construct, removing attitude toward use as a variable (as in TAM2), and removing the influence of PEU on PU (as in the UTAUT) (Goodarzi et al., 2016; B. Aldosari, 2012).

The study has the following variables:

Independent variables were:

1. Perceived Usefulness.
2. Perceived Ease of Use.
3. Change.
4. Socio-demographic characteristics.

Dependent variable was:

1. Behavior (Acceptance).

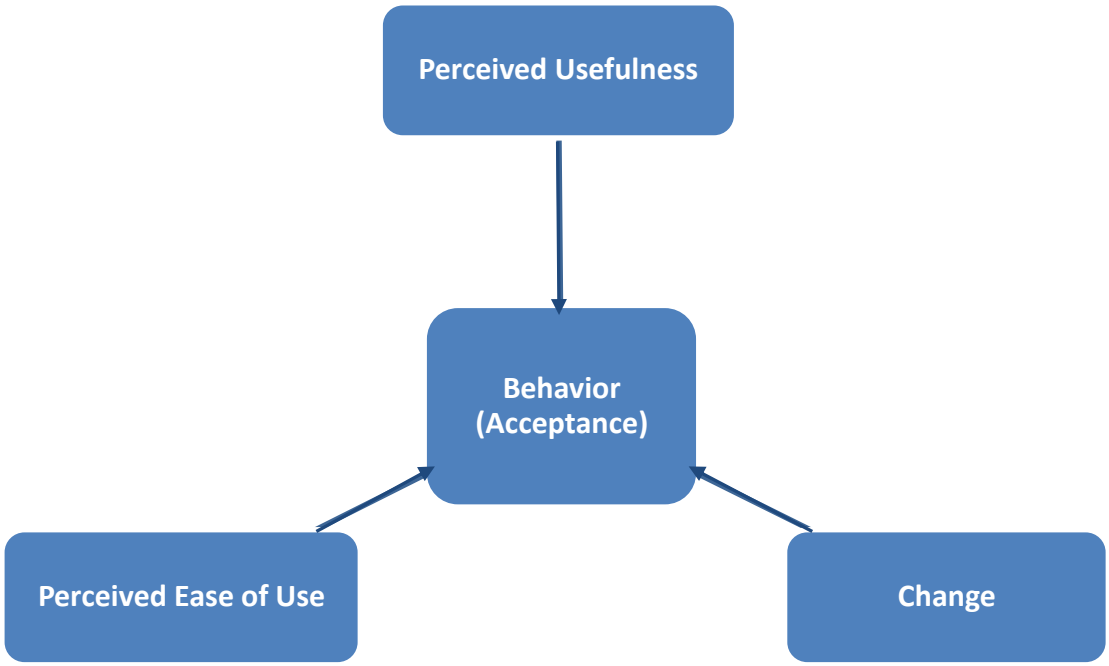

Figure 2- 3 Model framework used in this study

2.6 **Summary**

The previous studies have focused on the extent to which professionals and physicians accept the Picture Archiving and Communication Systems (PACS), and to compare between the traditional system and this system and studying the factors affecting the level of acceptance of PACS. Also, to determine how users felt about PACS and user satisfaction with PACS.

Some of these studies use technology acceptance model (TAM), and they assess the PACS. The acceptance is influenced by all three factors: PU, PEU, and change. Most studies

considered PACS to be a significant advancement and inevitable, but some issue need to be improved such as training.

In regional country a few studies were conducted about PACS most of them were in Saudi Arabia, also they use TAM to assess the acceptance level of PACS and to evaluate the success of PACS in clinical practice, they found that PACS was well-liked by physicians and radiologists due to its various advantages and had a positive effect on the diagnostic radiology department's radiologists and technologists.

PACS in Palestine still newly introduced technology, especially to governmental hospitals and the current study it will be the first one that assesses and evaluates the acceptance level of adopting PACS by using TAM.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The researcher presents subsequent sections in this chapter, study design, study settings, Study population and sample size, study instrument, reliability of the questionnaires, data collection , data analysis method, scale correction and ethical considerations.

3.2 Study design

The study was a descriptive cross-sectional design to evaluate the impact of PACS on Emergency Department work practice of Palestinian governmental hospitals, and the effectiveness of the PACS from the point of view of ER physicians and their acceptance level of PACS.

The study is quantitative and surveyed user's (physicians) perceptions, attitudes, and behaviors toward using picture Archiving and Communication System (PACS). Data collection was conducted between 5th of May to 25th of June, 2021.

3.3 Study setting

Governmental hospitals in Palestine were included in the study, twelve of them use PACS, and all physicians who work in emergency departments participated in the study.

3.4 Study population and sample size

The study population was all physicians working in emergency departments in governmental hospitals. The sample consisted of ER physicians in twelve governmental hospitals. Participation criteria include physicians working at the emergency department in the selected hospitals. The criteria for exclusion involved physicians who didn't work at the targeted departments. The study sample was composed of the entire physician's population who worked in the targeted emergency departments at governmental hospitals, it was 160 ER physicians.

3.5 Study instrument

In this study, the researcher used a questionnaire as an instrument. It was used previously in several studies (B. Aldosari, 2012; Goodarzi et al., 2016). It consisted of two parts, part one included questions about demographic characteristics of the participants including age, gender, and job title, how much experience of using PACS and how much they used the system in their daily practice. The demographic characteristics variables

including options as follow: 1. Gender (male, female); 2. Age (22-30, 31-39, 40-49, ≥50); 3. Job title (consultant, specialist, resident, other); 4. PACS experience (< one year, 1-2 year, ≥3), 5. Use PACS (always, frequently, in the past but not now).

Four sections were included in Part two of the questionnaire, the first one consisted of six statement measured perceived usefulness. The responses were graded on each item using a five-point likert scale: strongly disagree = 1, disagree = 2, neither agree/disagree = 3, agree = 4 and strongly agree = 5, and the statements shown in (Appendix A -2).

Second section contained four statements measuring perceived ease of use of the system also used the same previous five-point likert scale used in first section as shown (Appendix A-2).

Third section measured change contained the same question “How has the PACS made your job” repeated four times to make four statements with modified five point likert scale as shown in (Appendix A -2).

Last section contained ten statements measured user's behavior (acceptance) with respect to the PACS with the same likert scale used in first and second sections to grade the responses as shown in (Appendix A -2).

The questionnaire was adopted from literature and modified to fit and used in this study. It was reviewed and validated by five experts and specialized in the field including the supervisor (Appendix D). It was in the English language and then the researcher translated into Arabic by a subject-matter expert who has a high level of English and his mother tongue is Arabic (Appendix A -1).

3.6 **Reliability of the questionnaires**

Reliability was calculated by using the internal consistency method and calculated the Cronbach's Alpha reliability equation by using SPSS which was 0.816. This indicates that the value of the reliability of the questionnaire at the total score reached (81.6%) and thus the questionnaire has a high degree of reliability and are subject to dependence to achieve the study objectives. For newly created instruments, Cronbach's alpha should not be less than 0.70 (B. Aldosari, 2012).

3.7 **Data collection**

After approval was obtained from the Palestinian Ministry of Health to distribute the questionnaire to physicians working in emergency departments, the researcher distributed the questionnaire to all targeted departments in each hospital, where this was done face to face mostly, and then the filled-out questionnaire was collected and prepared for analysis.

It was explained to the physicians that the information provided by him/her will be for the purpose of scientific research only and will be confidential and will not be seen by anyone other than the researcher, and that he/she has the right not to answer any question.

3.8 **Data analysis**

Data were analyzed using the IBM Statistical Package for Social Sciences (SPSS) version20. Descriptive analysis for all variables in the questionnaire was performed. Including the frequencies, percentages, means, and standard deviations were done.

Pearson correlation coefficient analysis was used to check any significant relationship between (TAM) variables including (PU), (PEU), (Change), and (Behavior). Analysis of variance (ANOVA) and Independent - Samples T Test were also performed to check the differences and relationships between (TAM) variables and other demographic factors (age, gender, job title, PACS experience, use PACS), with a significance level of 95%, the relationship is considered statistically significant when (P-Value ≤ 0.05).

3.9 **Scale correction**

The five-point Likert scale was used, which is a method for measuring behaviors and is used in questionnaires, especially in statistics. The scale is based on responses indicating the degree of approval or objection. Then the average is calculated to determine the degree of the impact of the PACS and user's acceptance level from the point of view of emergency department physicians. The following levels have been adopted:

Very low, Low, Moderate, High and very high as shown in Table (3-1) below

.Table 3- 1 The Levels Of Respondents' Answers To The Questionnaire Questions Based On The Mean

Level	Mean
Very low	1.00 – 1.80
Low	1.81 – 2.60
Moderate	2.61 – 3.40
High	3.41 – 4.20
Very high	4.21 – 5.00

3.10 **Ethical considerations**

The researcher obtained permission for distributing the questionnaires from the Palestinian ministry of health (Appendix C). The researcher also included an information sheet outlining the objectives of this study and confirming that participation was optional and that the participants' information would be kept confidential and used exclusively for scientific research purposes. The physicians' privacy and confidentiality were protected, and the participants were assured that they did not need to give data such as their name, address, or any other information that may be used to identify them. The researcher described the research objectives and the structure of the questionnaire to the participants before collecting their responses to make them understand the study and the questionnaire objectives.

CHAPTER FOUR

RESULTS

4.1 Introduction

The data collected through questionnaires were analyzed in this chapter. After transforming the digital data into useable information that can be used to provide answers to the study questions, statistical methods allow the researcher to analyze, interpret, and conclude. The type of study, the data collection methods, and the research questions to be answered all influence the data analysis methodologies. The researcher analyzed schedules and interpreted the data collected in this chapter to make a conclusion.

In this chapter the following sections will be presented: Response rate, Demographic Characteristics Data, Descriptive statistics of part two of the questionnaire TAM variables, Relationship between PACS and socio-demographic characteristics.

4.2 Response rate

The study population consisted of all physicians working in the emergency departments 12 governmental hospitals in Palestine. 135 out of 160 questionnaires were completed with response rate 84.37%. Based on literature, response rates must be more

than 60% (Fincham, 2008). So the response rate in this study was very good, and therefore the results will be reflected on the study population.

4.3 **Demographic characteristics data**

The results as shown in Table (4-1) below showed, with regard to gender, that most of the study participants were males, numbering 112 people, who accounted for 83.0% of the total participants. As for age, the majority of the participants were from the age group between 22-30 years (53.3%), followed by the age group between 31-39 years (29.6%), and the lowest percentage was for the age group greater than 50 years (3.7%). Moreover, 99 of the study participants were resident (73.3%), 18 were specialist (13.3%), also 18 were other title (13.3%), and finally there were no consultants in the study participant (0.0%).

As for years of experience of using PACS, the majority of study participants had more than 3 years of experience (43.0%), followed by those with 1 to 2 years of experience (33.3%) and finally those with less than 1 year of experience (23.7%). The majority of the participants used PACS always (67.4%), and (29.6%) of participants frequently used PACS, finally (3.0%) of participants used PACS in the past but not now.

Table 4- 1 Socio-Demographic Characteristics of Physicians.

Characteristics		Frequency	Percentage (%)
Gender	Male	112	83.0
	Female	23	17.0
Age	22-30	72	53.3
	31-39	40	29.6
	40-49	18	13.3
	≥50	5	3.7
Job Title	Consultant	0	0.0
	Specialist	18	13.3
	Resident	99	73.3
	Other	18	13.3
PACS Experience	< one year	32	23.7
	1-2 year	45	33.3
	≥ 3 years	58	43.0
Use PACS	always	91	67.4
	frequently	40	29.6
	In the past but not now	4	3.0

4.4 Descriptive statistics of part two of the questionnaire TAM variables

Part two of the questionnaire was TAM variables consisting of 4 sections which are measuring of Perceived Usefulness (PU), Perceived Ease of Use (PEU), Change and Behavior (Acceptance).

The overall median score for all sections as shown in Table (4-2) was (3.846) with a mean score (3.811) and standard deviation (±0.403). Table (4-2) also showed the descriptive statistics of each section separately as follows: The median score for PU section was (4.0) with a mean score (4.059) and standard deviation (±0.645). The median score for PEU section was (4.0) with a mean score (4.072) and standard deviation (±0.612). The median score for change section was (4.0) with a mean score (3.996) and standard deviation (±0.576). The median score for behavior (acceptance) section was (3.10) with a mean score (3.118) and standard deviation (±0.350).

Table 4- 2 Median, Mean and Standard deviation for sections.

Section	Median	Mean	Standard deviation(±)
Perceived Usefulness (PU)	4.000	4.059	0.645
Perceived Ease of Use (PEU)	4.000	4.072	0.612
Change	4.000	3.996	0.576
Behavior (Acceptance)	3.100	3.118	0.350
Overall sections	3.846	3.811	0.403

4.4.1 Perceived Usefulness (PU):

PU was measured using 6 items presented in Table (4-3), and the overall average of (PU) was 4.059 and is considered as high.

Table 4- 3 Descriptive Statistics of PU Items

Descriptive Statistics of PU Items			
Item	N	Mean	Std. Deviation
Using PACS has made my job easier to perform.	135	4.20	0.741
Using PACS enables me to accomplish tasks more quickly.	135	4.19	0.777
Using PACS has improved the quality of my work in providing better patient care.	135	4.19	0.725
Total average mean for section	135	4.059	0.645
Using PACS has enhanced my effectiveness on the job.	135	3.96	0.823
Using PACS has increased my productivity.	135	3.96	0.854
Using PACS has given me greater control over my work schedule.	135	3.86	0.793
Valid N (listwise)	135		

4.4.2 Perceived Ease of Use (PEU):

PEU was measured using 4 items presented in Table (4-4), and the overall average of (PEU) was 4.072 and is considered as high.

Table 4- 4 Descriptive Statistics of PEU Items.

Descriptive Statistics of PEU Items			
Item	N	Mean	Std. Deviation
Learning to use the PACS has been easy for me.	135	4.10	0.715
My interaction with the PACS has been understandable.	135	4.08	0.681
It is easy to become skillful at using the PACS.	135	4.07	0.739
Total average mean for section	135	4.072	0.612
My interaction with the PACS has been clear.	135	4.03	0.701
Valid N (listwise)	135		

4.4.3 Change:

Change was measured using 4 items presented in Table (4-5), and the overall average of change was 3.996 and is considered as high.

Table 4- 5 Descriptive Statistics of Change Items.

Descriptive Statistics of Change Items			
Item	N	Mean	Std. Deviation
How has the PACS made your job (extremely more stressful, more stressful, Neutral, Stressful, Less stressful)	135	4.47	0.836
How has the PACS made your job (Easier, Difficult, Neutral, Easy, More difficult)	135	4.05	0.736
Total average mean for section	135	3.996	0.576
How has the PACS made your job (Extremely less pleasant, less pleasant, Neutral, Pleasant, More pleasant)	135	3.76	0.755
How has the PACS made your job (More interesting, less interesting, Neutral, Interesting, Not interesting)	135	3.70	0.683
Valid N (listwise)	135		

4.4.4 Behavior (Acceptance):

Behavior (Acceptance) was measured using 10 items presented in Table (4-6), and the overall average of Behavior (Acceptance) was 3.118 and is considered as Moderate.

Table 4- 6 Descriptive Statistics of Acceptance Items.

Descriptive Statistics of Acceptance Items			
Item	N	Mean	Std. Deviation
I recommend using PACS to other emergency departments.	135	4.39	0.658
I prefer PACS to the traditional system of paper-based and film-based printing.	135	3.86	1.265
PACS system is admirable and I like it.	135	3.81	0.768
I enjoy working on the PACS.	135	3.79	0.764
I rarely make a mistake or commit an error while using PACS.	134	3.34	1.011
Total average mean for section	135	3.118	0.35007
There is a lack of cooperation among the personnel when using PACS.	135	2.59	0.949
Use of PACS requires a high level of proficiency.	135	2.50	0.854
Use PACS is often annoying and results in my complaining about it.	135	2.40	0.932
The PACS slows my work performance.	135	2.29	0.969
It is difficult to learn how to use PACS.	135	2.22	0.798
Valid N (listwise)	134		

The following are descriptive statistics for some of the items in each section: as shown in Table (4-3) above for Perceived Usefulness (PU) section, the item (Using PACS has made my job easier to perform) had the highest degree of approval where the mean was (4.20) and standard deviation (±0.74) followed by the item (Using PACS enables me to accomplish tasks more quickly) with the mean (4.19) and standard deviation (±0.78) then (Using PACS has improved the quality of my work in providing better patient care) with the same mean as previous item (4.19) and standard deviation (±0.73), while the item (Using PACS has given me greater control over my work schedule) has the lowest degree of approval where the mean was (3.86) and standard deviation (±0.08) followed by the item (Using PACS has increased my productivity) with the mean (3.96) and standard deviation (±0.86) then (Using PACS has enhanced my effectiveness on the job) with the same mean (3.96) and standard deviation (±0.82).

For Perceived Ease of Use (PEU) section as shown in Table (4-4) above, the item (Learning to use the PACS has been easy for me) had the highest degree of approval where the mean was (4.10) and standard deviation (0.72) followed by the item (My interaction with the PACS has been understandable) with the mean (4.08) and standard deviation (0.68), then (It is easy to become skillful at using the PACS) with the mean (4.07) and standard deviation (0.74) while the item (My interaction with the PACS has been clear) had the lowest degree of approval where the mean was (4.03) and standard deviation (0.7).

For Change section as shown in Table (4-5) above, the item (How has the PACS made your job {extremely more stressful, more stressful, Neutral, Stressful, Less stressful}) had the highest degree of approval where the mean was (4.47) and standard

deviation (±0.84) followed by the item (How has the PACS made your job {Easier, Difficult, Neutral, Easy, More difficult}) with the mean (4.05) and standard deviation (±0.74), while the item (How has the PACS made your job {More interesting, less interesting, Neutral, Interesting, Not interesting}) Has the lowest degree of approval where the mean was (3.70) and standard deviation (±0.68) followed by the item (How has the PACS made your job {extremely less pleasant, less pleasant, Neutral, Pleasant, More pleasant}) with the mean (3.76) and standard deviation (±0.76).

For Behavior (Acceptance) section as shown in Table (4-6) above, the item (I recommend using PACS to other emergency departments) had the highest degree of approval where the mean was (4.39) and standard deviation (±0.66) followed by the item (I prefer PACS to the traditional system of paper-based and film-based printing) with the mean (3.86) and standard deviation (±1.27), then (PACS system is admirable and I like it) with the mean (3.81) and standard deviation (±0.77) while the item (It is difficult to learn how to use PACS) had the lowest degree of approval where the mean was (2.22) and standard deviation (±0.80) followed by the item (The PACS slows my work performance) with the mean (2.29) and standard deviation (±0.97) .

4.5 **Relationship between PACS and socio-demographic characteristics**

Independent - Samples T Test and Analysis of Variance (ANOVA) were conducted to verify whether there was a difference in the impact and user's acceptance of

implementing PACS in the emergency departments due to the difference in socio-demographic characteristics.

4.5.1. According to the gender

As shown in Table (4-7) below the P-value (Sig.) for PU, PEU, Change, Acceptance and for total TAM score are (0.49, 0.25, 0.68, 0.87, 0.99) respectively are higher than the significance level α=0.05. This result indicates there are no significant differences between the physicians in their opinions about impact and acceptance of implementing PACS in the emergency departments based due to gender variable. The participant's answers for total TAM variables for male were of a high degree, the mean was (3.81) and standard deviation ($\pm$0.41) while the participant's answers for female were also of a high degree, the mean was (3.81) and standard deviation ($\pm$0.37) as shown in Table (4-8) below.

Table 4- 7 Independent - Samples T Test for TAM Variables with Gender.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PU	Equal variances assumed	0.863	0.355	-0.698-	133	0.486	-0.10326-	0.14787	-0.39574-	0.18921
	Equal variances not assumed			-0.698-	31.692	0.490	-0.10326-	0.14790	-0.40464-	0.19811
PEU	Equal variances assumed	0.525	0.470	1.091	133	0.277	0.15256	0.13989	-0.12414-	0.42926
	Equal variances not assumed			1.169	34.136	0.250	0.15256	0.13046	-0.11252-	0.41764
Change	Equal variances assumed	1.579	0.211	-0.430-	133	0.668	-0.05687-	0.13232	-0.31860-	0.20486
	Equal variances not assumed			-0.411-	30.422	0.684	-0.05687-	0.13832	-0.33920-	0.22545
Acceptance	Equal variances assumed	1.441	0.232	0.139	133	0.890	0.01115	0.08043	-0.14795-	0.17024
	Equal variances not assumed			0.170	40.876	0.866	0.01115	0.06567	-0.12149-	0.14379
Total_TAM	Equal variances assumed	0.176	0.676	0.010	133	0.992	0.00089	0.09261	-0.18228-	0.18407
	Equal variances not assumed			0.010	33.969	0.992	0.00089	0.08673	-0.17537-	0.17716

Table 4- 8 Mean for Participant's Answers According to Gender.

Group Statistics					
	gender	N	Mean	Std. Deviation	Std. Error Mean
PU	Male	112	4.0417	0.64588	0.06103
	Female	23	4.1449	0.64609	0.13472
PEU	Male	112	4.0982	0.62092	0.05867
	Female	23	3.9457	0.55880	0.11652
Change	Male	112	3.9866	0.57131	0.05398
	Female	23	4.0435	0.61076	0.12735
Acceptance	Male	112	3.1198	0.36565	0.03455
	Female	23	3.1087	0.26784	0.05585
Total_TAM	Male	112	3.8116	0.41067	0.03880
	Female	23	3.8107	0.37198	0.07756

4.5.2 According to age

As shown in Table (4-9) below the P-value (Sig.) for PU (0.03) was lower than the significance level α=0.05. This result indicates significant differences between the physicians in their opinions about perceived usefulness of PACS in the emergency departments based due to age group variable. While the P-value (Sig.) for PEU, Change, Acceptance and for total TAM score (0.06, 0.36, 0.13, 0.11) respectively were higher than the significance level α=0.05. This result indicates there are no significant differences between the physicians in their opinions about impact and acceptance of implementing PACS in the emergency departments based on age group variable. The participant's answers for total TAM variables with age groups (22-30), (31-39), (40-49), (50 and more)

were of a high degree, the means were (3.76, 3.89, 3.76, and 4.14) respectively and standard deviation were (±0.45, ±0.34, ±0.33, ±0.20) respectively as shown in Table (4-10) below.

Table 4- 9 ANOVA Test for TAM Variables with Age.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	3.746	3	1.249	3.149	0.027
	Within Groups	51.947	131	0.397		
	Total	55.693	134			
PEU	Between Groups	2.705	3	0.902	2.492	0.063
	Within Groups	47.403	131	0.362		
	Total	50.108	134			
Change	Between Groups	1.070	3	0.357	1.076	0.362
	Within Groups	43.428	131	0.332		
	Total	44.498	134			
Acceptance	Between Groups	0.688	3	0.229	1.908	0.131
	Within Groups	15.734	131	0.120		
	Total	16.421	134			
Total_TAM	Between Groups	.993	3	0.331	2.088	0.105
	Within Groups	20.771	131	0.159		
	Total	21.765	134			

Table 4- 10 Mean for Participants' Answers According to Age.

		N	Mean	Std. Deviation	Std. Error
PU	22-30	72	3.9861	0.67989	0.08013
	31-39	40	4.2500	0.49210	0.07781
	40-49	18	3.8148	0.71375	0.16823
	50 and more	5	4.4667	0.50553	0.22608
	Total	135	4.0593	0.64468	0.05549
PEU	22-30	72	4.0313	0.66600	0.07849
	31-39	40	4.1875	0.52730	0.08337
	40-49	18	3.8472	0.50102	0.11809
	50 and more	5	4.5500	0.44721	0.20000
	Total	135	4.0722	0.61151	0.05263
Change	22-30	72	3.9236	0.59582	0.07022
	31-39	40	4.0313	0.58339	0.09224
	40-49	18	4.1667	0.53550	0.12622
	50 and more	5	4.1500	0.13693	0.06124
	Total	135	3.9963	0.57626	0.04960
Acceptance	22-30	72	3.1003	0.33953	0.04001
	31-39	40	3.0700	0.36948	0.05842
	40-49	18	3.2167	0.32222	0.07595
	50 and more	5	3.4000	0.33912	0.15166
	Total	135	3.1179	0.35007	0.03013
Total_TAM	22-30	72	3.7603	0.44874	0.05288
	31-39	40	3.8847	0.34033	0.05381
	40-49	18	3.7613	0.32519	0.07665
	50 and more	5	4.1417	0.19957	0.08925
	Total	135	3.8114	0.40302	0.03469

4.5.3 According to job title

As shown in Table (4-11) below the P-value (Sig.) for PU, PEU, Change, Acceptance and for total TAM score were (0.28, 0.65, 0.66, 0.66, 0.90) respectively are higher than the significance level α=0.05. This result indicates there are no significant differences between the physicians in their opinions about impact and acceptance of implementing PACS in the emergency departments based due to job title variable. The participant's answers for total TAM variables for specialist, resident and others were of a high degree, the means were (3.78, 3.82, 3.80) respectively and standard deviation were (0.29, 0.44, 0.30) respectively as shown in Table (4-12) below.

Table 4- 11 ANOVA Test for TAM Variables with Job Title.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	1.064	2	0.532	1.286	0.280
	Within Groups	54.628	132	0.414		
	Total	55.693	134			
PEU	Between Groups	0.323	2	0.162	0.429	0.652
	Within Groups	49.785	132	0.377		
	Total	50.108	134			
Change	Between Groups	0.284	2	0.142	0.423	0.656
	Within Groups	44.215	132	0.335		
	Total	44.498	134			
Acceptance	Between Groups	0.101	2	0.051	0.410	0.664
	Within Groups	16.320	132	0.124		
	Total	16.421	134			
Total_TAM	Between Groups	0.035	2	0.018	0.106	0.899
	Within Groups	21.730	132	0.165		
	Total	21.765	134			

Table 4- 12 Mean for Participants' Answers According to Job Title.

		N	Mean	Std. Deviation	Std. Error
PU	specialist	18	3.8426	0.73314	0.17280
	resident	99	4.1044	0.66222	0.06656
	others	18	4.0278	0.38455	0.09064
	Total	135	4.0593	0.64468	0.05549
PEU	specialist	18	3.9722	0.37268	0.08784
	resident	99	4.1010	0.66521	0.06686
	others	18	4.0139	0.48864	0.11517
	Total	135	4.0722	0.61151	0.05263
Change	specialist	18	4.1111	0.51608	0.12164
	resident	99	3.9747	0.60976	0.06128
	others	18	4.0000	0.43724	0.10306
	Total	135	3.9963	0.57626	0.04960
Acceptance	specialist	18	3.1778	0.36711	0.08653
	resident	99	3.1022	0.36456	0.03664
	others	18	3.1444	0.24307	0.05729
	Total	135	3.1179	0.35007	0.03013
Total_TAM	specialist	18	3.7759	0.29466	0.06945
	resident	99	3.8206	0.43733	0.04395
	others	18	3.7965	0.29811	0.07026
	Total	135	3.8114	0.40302	0.03469

4.5.4 According to years of experience

As shown in Table (4-13) below the P-value (Sig.) for PU, PEU, Acceptance and for total TAM score were (0.36, 0.78, 0.06, 0.24) respectively are higher than the significance level α=0.05. This result indicates there are no significant differences between the physicians in their opinions about impact and acceptance of implementing

PACS in the emergency departments based due to PACS experience variable. While the P-value (Sig.) for Change (0.01) was lower than the significance level α=0.05. This result indicates significant differences between the physicians in their opinions about (Change) variable in the emergency departments based due to PACS experience variable. The participant's answers for total TAM variables for PACS experience groups (less than 1 year, 1-2 year, 3 years and more) were of a high degree, the means were (3.72, 3.80, 3.87) respectively and standard deviation were (±0.34, ±0.36, ±0.46) respectively as shown in Table (4-14) below.

Table 4- 13 ANOVA Test for TAM Variables with Years of Experience.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	0.862	2	0.431	1.038	0.357
	Within Groups	54.830	132	0.415		
	Total	55.693	134			
PEU	Between Groups	0.192	2	0.096	.254	0.776
	Within Groups	49.916	132	0.378		
	Total	50.108	134			
Change	Between Groups	2.882	2	1.441	4.570	0.012
	Within Groups	41.617	132	0.315		
	Total	44.498	134			
Acceptance	Between Groups	0.692	2	0.346	2.902	0.058
	Within Groups	15.730	132	0.119		
	Total	16.421	134			
Total_TAM	Between Groups	0.463	2	0.231	1.434	0.242
	Within Groups	21.302	132	0.161		
	Total	21.765	134			

Table 4- 14 Mean for Participants' Answers According to Years of Experience.

		N	Mean	Std. Deviation	Std. Error
PU	less than 1 year	32	3.9167	0.59719	0.10557
	1-2 year	45	4.0926	0.58339	0.08697
	3 years and more	58	4.1121	0.71081	0.09333
	Total	135	4.0593	0.64468	0.05549
PEU	less than 1 year	32	4.0156	0.47066	0.08320
	1-2 year	45	4.1167	0.58290	0.08689
	3 years and more	58	4.0690	0.70212	0.09219
	Total	135	4.0722	0.61151	0.05263
Change	less than 1 year	32	3.7656	0.51953	0.09184
	1-2 year	45	3.9778	0.58587	0.08734
	3 years and more	58	4.1379	0.56423	0.07409
	Total	135	3.9963	0.57626	0.04960
Acceptance	less than 1 year	32	3.1851	0.29856	0.05278
	1-2 year	45	3.0178	0.30097	0.04487
	3 years and more	58	3.1586	0.39693	0.05212
	Total	135	3.1179	0.35007	0.03013
Total_TAM	less than 1 year	32	3.7207	0.33520	0.05926
	1-2 year	45	3.8012	0.35986	0.05365
	3 years and more	58	3.8694	0.46113	0.06055
	Total	135	3.8114	0.40302	0.03469

4.5.5 According to use PACS

As shown in Table (4-15) below the P-value (Sig.) for Change and Acceptance were (0.10, 0.87) respectively are higher than the significance level α=0.05. This result indicates there are no significant differences between the physicians in their opinions on change and acceptance about impact and acceptance of implementing PACS in the emergency departments based due to use PACS variable. While the P-value (Sig.) for PU,

PEU, and for total TAM score were (0.01, 0.003, 0.009) respectively are lower than the significance level α=0.05. This result indicates there are significant differences between the physicians in their opinions about impact and acceptance of implementing PACS in the emergency departments based due to use PACS variable. The participant's answers for total TAM variables for (always, frequently, in the past but not now) were of a high degree, the means were (3.88, 3.67, 3.56) respectively and standard deviation were (0.35, 049, 0.32) respectively as shown in Table (4-16) below.

Table 4- 15 ANOVA Test for TAM Variables with Use PACS.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	3.559	2	1.780	4.506	0.013
	Within Groups	52.133	132	0.395		
	Total	55.693	134			
PEU	Between Groups	4.161	2	2.080	5.977	0.003
	Within Groups	45.948	132	0.348		
	Total	50.108	134			
Change	Between Groups	1.504	2	0.752	2.309	0.103
	Within Groups	42.994	132	0.326		
	Total	44.498	134			
Acceptance	Between Groups	0.034	2	0.017	0.136	0.873
	Within Groups	16.388	132	0.124		
	Total	16.421	134			
Total_TAM	Between Groups	1.508	2	0.754	4.912	0.009
	Within Groups	20.257	132	0.153		
	Total	21.765	134			

Table 4- 16 Mean for Participants' Answers According to Use PACS.

		N	Mean	Std. Deviation	Std. Error
PU	Always	91	4.1722	0.64140	0.06724
	Frequently	40	3.8250	0.61550	0.09732
	In the past but not now	4	3.8333	0.33333	0.16667
	Total	135	4.0593	0.64468	0.05549
PEU	Always	91	4.1868	0.54339	0.05696
	Frequently	40	3.8688	0.69795	0.11036
	In the past but not now	4	3.5000	0.35355	0.17678
	Total	135	4.0722	0.61151	0.05263
Change	Always	91	4.0687	0.52050	0.05456
	Frequently	40	3.8563	0.66720	0.10549
	In the past but not now	4	3.7500	0.64550	0.32275
	Total	135	3.9963	0.57626	0.04960
Acceptance	Always	91	3.1079	0.30385	0.03185
	Frequently	40	3.1350	0.45038	0.07121
	In the past but not now	4	3.1750	0.23629	0.11815
	Total	135	3.1179	0.35007	0.03013
Total_TAM	Always	91	3.8839	0.34521	0.03619
	Frequently	40	3.6713	0.48621	0.07688
	In the past but not now	4	3.5646	0.32251	0.16125
	Total	135	3.8114	0.40302	0.03469

Answer the research questions:

Research question 1: What is the user's acceptance level of PACS in emergency departments in governmental Palestinian hospitals?

For Behavior (Acceptance) section as shown in Table (4-6) above, the item (I recommend using PACS to other emergency departments) had the highest degree of approval where the mean was (4.39) and standard deviation (±0.66) followed by the item (I prefer PACS to the traditional system of paper-based and film-based printing) with the mean (3.86) and standard deviation (±1.27), then (PACS system is admirable and I like it) with the mean (3.81) and standard deviation (±0.77) while the item (It is difficult to learn how to use PACS) has the lowest degree of approval where the mean was (2.22) and standard deviation (±0.80) followed by the item (The PACS slows my work performance) with the mean (2.29) and standard deviation (±0.97).

According to table (4-17) below the overall acceptance level was of a Moderate degree with mean 3.11 and standard deviation ±0.35. While overall TAM variable were of a high degree with mean 3.81 and standard deviation ±0.40.

Table 4- 17 Descriptive Statistics for Total_TAM and Acceptance.

Descriptive Statistics				
	N	Mean	Std. Deviation	Variance
Acceptance	135	3.1179	0.35007	0.123
Total_TAM	135	3.8114	0.40302	0.162
Valid N (listwise)	135			

Research question 2: What is the relationship between (PU, PEU, Change) and Behavior (user's acceptance) of PACS in emergency departments in governmental Palestinian hospitals?

From the results of the correlation analysis presented in Table (4-18) and Table (4-19) below P-value=0.005 and mean (4.04), that indicate there is positive statistically significance between PU, PEU, Change as total score and Acceptance.

Table 4- 18 Pearson Correlation for PU,PEU,Change with Acceptance.

		PU, PEU, Change
PU, PEU, Change	Pearson Correlation	1
	Sig. (2-tailed)	
	N	135
Acceptance	Pearson Correlation	0.240**
	Sig. (2-tailed)	0.005
	N	135

Table 4- 19 Descriptive Statistcs for PU,PEU,Change with Acceptance.

Descriptive Statistics			
	Mean	Std. Deviation	N
PU, PEU, Change	4.0426	0.49728	135
Acceptance	3.1179	0.35007	135

Research question 3: Which factor from TAM has the highest impact on user acceptance of PACS?

To predict the highest variable that affects the acceptance as dependent variable from TAM variables multiple regression models was used. According to the Table (4-20) below PU and Change had a statistically significant effect in prediction of acceptance, and with no statistically significant effect from PEU. The highest influencing factor was change with the beta of 0.239 (P value=0.005). Then was PU with beta of 0.198 (P value=0.021).

Table 4- 20 Summary of Multiple Regression.

Independent Variable	R	R Square	Beta	F	Sig
PU	0.198[a]	0.039	0.198	5.413	0.021
PEU	0.152[a]	0.023	0.152	3.131	0.079
Change	0.239[a]	0.057	0.239	8.053	0.005

Research question 4: What is the impact of socio-demographic variables on the user's acceptance level?

According to Tables above from (4-7) to (4-16) there is no statistically significant effect between gender, age, job title, years of experience and use of PACS with overall acceptance score with P-value (0.87, 0.13, 0.66, 0.06, 0.87) respectively. That indicates there is no impact on the overall acceptance from socio-demographic variables.

Research question 5: Is PACS considered a useful system and can it improves patient care from user's point of view?

According to Table (4-3) the overall PU was of a high degree with mean (4.1±0.6). The item (Using PACS has made my job easier to perform) had the highest degree of approval where the mean was (4.2±0.7) followed by the item (Using PACS enables me to accomplish tasks more quickly) with the mean (4.19±0.7) then (Using PACS has improved the quality of my work in providing better patient care) with the same mean as previous item (4.19±0.7) that's indicate PACS consider useful system from the point of view of physicians and it improves the patient care.

Research question 6: To what extent does the PACS change the user's practice?

For Change section as shown in Table (4-5), the item (How has the PACS made your job {extremely more stressful, more stressful, Neutral, Stressful, Less stressful}) less stressful had the highest degree of approval where the mean was (4.47) and standard deviation (±0.84) followed by the item easy (How has the PACS made your job {Easier, Difficult, Neutral, Easy, More difficult}) with the mean (4.05) and standard deviation (±0.74), while the item interesting (How has the PACS made your job {More interesting, less interesting, Neutral, Interesting, Not interesting}) had the lowest degree of approval where the mean was (3.70) and standard deviation (±0.68) followed by the item pleasant (How has the PACS made your job {extremely less pleasant, less pleasant, Neutral, Pleasant, More pleasant}) with the mean (3.76) and standard deviation (±0.76),

this indicates that using PACS makes the practice for physicians less stressful, easy, pleasant and interesting.

Research question 7: Is PACS considered easy to use system? And is it recommended?

According to Table (4-4) and Table (4-6) above, for Perceived Ease of Use (PEU) section, the item (Learning to use the PACS has been easy for me) had the highest degree of approval where the mean was (4.10) and standard deviation (±0.72) and For Behavior (Acceptance) section the item (I recommend using PACS to other emergency departments) had the highest degree of approval where the mean was (4.39) and standard deviation (±0.66) that indicates that the PACS is considered easy to use and is recommended system.

4.6 Summary

This chapter included a description of the research results, including the participant characteristics and descriptive statistics from the questionnaire data, as well as the results of inferential statistics on the relationship between TAM variables and socio-demographic characteristics of participants. In addition, the answers of the research questions were reported in this chapter.

CHAPTER FIVE

DISCUSSION & CONCLUSION

5.1 Introduction

This section discusses the study's findings in terms of causes and how they compare to previous regional and global researches. Also, this chapter presents conclusion, recommendations, strength and limitations of the study and future studies.

5.2 Discussion

The current study showed that the overall acceptance level was of a Moderate degree while in, the study by B. Aldosari, 2012 found that the acceptance level was with a high degree (3.86). The TAM model was used also in B. Aldosari, 2012 study to assess the level of acceptance of the host PACS by staff in the radiology department. In addition study by Goodarzi et al., 2016 that used TAM model had shown that Participants with the specialty degree had acceptance scores higher than the three other groups, this study aimed to assess and compare user's acceptance of PACS in the emergency departments of three different hospitals and to investigate the effect of socio-demographic factors on this acceptance.

Study of Duyck et al., 2008 aimed to gain insight into the individual user's acceptance of PACS by the radiology department staff mentioned that both radiologists and technologists were positive towards PACS and had strong intentions to use PACS.

Study of Ling & Lewis, 2010 confirms that the use of PACS has positive impact on the users and work practice, 83% of respondents of their study felt PACS benefited their work, 79% felt PACS was better than hard copies.

Salih, n.d. study used another model called the UTAUT model, the results had shown that the model can explain about 61 percent of the variance in the adoption of PACS. Also showed that performance expectancy, effort expectancy, social influences, and behavior intention have a direct and significant effect on the adoption of PACS.

According to result of Ahmadi et al., 2017 study accepting the use of PACS in hospitals are quite influenced by Performance and effort expectancies.

There is a positive statistically significant between PU, PEU, Change as total score, and Acceptance in the current study, comparing with study of Goodarzi et al., 2016 the three variables of PU, PEU and change also had a significant effect on prediction of acceptance. In addition, the overall acceptance was significantly related to the three constructs (change, PU, and PEU) on the study of B. Aldosari, 2012.

In a study by Salih, n.d. result shown that behavior intention has a direct and significant effect on PACS usage. Also, performance expectancy, effort expectancy, and social influences have a direct and significant effect on behavior intention. Nevertheless, Facility condition has no significant effect on behavior intention.

Contrary to the study of Salih, n.d. Facilitating conditions proved to be the strongest predictor of behavioral intention in the study of Duyck et al., 2008 and performance expectancy was salient for predicting behavioral intention, Both effort expectancy and social influence were not salient for predicting behavioral intention.

Also in study of Ahmadi et al., 2017 Expected performances, efforts expectancy, social impact and facilitating conditions had a significant relationship with behavioral intention, these studies used Unified Theory of Acceptance and Use of Technology (UTAUT).

Compared with studies of Goodarzi et al., 2016 and B. Aldosari, 2012 the highest impact of TAM variables on overall user's acceptance of PACS in this study was change factor as in study of 4, while in study of B. Aldosari, 2012 was PU, This result may be due to that current study setting was emergency departments which is always crowded and busy and the PACS made differences and changes for the practice in these departments from the participants point of view.

In addition, compared with the same studies the current study showed that no impact on the overall acceptance from socio-demographic variables compatible with results of Goodarzi et al., 2016 and B. Aldosari, 2012.

By reviewing literature results it turns out that the majority considered the PACS useful system and improves patient care. Current study results show that PU had a high degree. Study by Top, 2012 showed that the majority of physicians judged PACS to be a major advance for their hospitals and improvement in their practice and patient care. In addition, study by Goodarzi et al., 2016 showed that most of the respondents recognized PACS as a useful and simple tool in their daily practice, and Approximately fifty eight

percent of the physicians agreed that using PACS is a great achievement for their hospitals and about fifty six percent of physicians believed that PACS has improved the quality of care according to study of Abbasi et al., 2020.

Moreover, in study of Alalawi et al., 2016 considered 70% physicians' views affirms that PACS improved physicians' efficiency, the respondents strongly agreed that the PACS has been a useful tool for practicing their profession in study of B. Aldosari, 2012, and the results showed 94 % agreeing that PACS had been a useful tool for the hospital according to Jorwekar et al., 2015. Also, the majority of responders felt PACS was useful in most circumstances, and eighty three percent agreed that PACS has positively benefited their work as result of study of Ling & Lewis, 2010.

Compared with studies of Goodarzi et al., 2016 and B. Aldosari, 2012 the current study shown according to change variables that PACS make physicians job less stressful, easy, pleasant and interesting, while study of Goodarzi et al., 2016 shown eighty one percent of participants reported that PACS makes their job much easier. Moreover respondents of study of B. Aldosari, 2012 reported that the PACS have made their job easy, interesting pleasant and less stressful as the same result to current study.

PACS considered easy use system and is recommended according to the current study and also the respondents rated the PACS highly in terms of ease of use of the system in study of B. Aldosari, 2012 and in study of Ling & Lewis, 2010 eighty three percent of respondents recommended it.

5.3 Conclusion

There is a lack of studies that concern the user's acceptance of PACS system and its impact in Arab countries, and this study is the first one in Palestine and first study that focuses on user's acceptance of PACS and its impact on the emergency department in Arab countries.

In this study, the researcher used TAM model to evaluate the impact of PACS on emergency departments and to measure the user's acceptance for this system, the model is the gold standard model, and the user's acceptance is an important factor in the success of healthcare IT adoption and implementation.

From the results, it's noted that PACS is recommended system from the point of view of emergency physicians. The overall acceptance level was of a Moderate degree, change factor was the highest influencing factor, PACS made the physicians practice less stressful, easy, pleasant and interesting, and they consider it easy to use system and it improves the quality of their work leading to better patient care.

Finally, the impact of PACS on emergency departments work practice is positively effect and it confirms that it improves patient health care in general.

5.4 Recommendations

The researcher recommended the following based on the results of this study:

- Paying attention to hardware and keep it up-to-date to maximize the use of PACS system and to avoid slowing work performance.

- It recommends adopting the PACS system in the new governmental hospital, also recommends adopting in private hospitals to improve overall healthcare.

- Adopting a mechanism to standardize the use of the PACS system between the public (governmental) sector and the private sector, due to its benefits to the public health of the community.

- Paying attention to trains staff on PACS in a manner that increases productivity not just quick work so that increases the Perceived Usefulness.

- Enhancing cooperation between employees when using the PACS system to improve benefits.

5.5 Strength of the study

The strength of this study stems from the fact that it is the first study in Palestine that highlight the impact of PACS since its newly implemented and its first one that use

TAM model to measure user's acceptance of PACS in emergency departments in Arabs countries.

The study measures the PU, PEU, Change and acceptance factors and relationship between this factors and its effect in overall user's acceptance. The results of the study provide a good impression about positive impact of PACS in emergency department and it's useful for healthcare sector in Palestine.

Research results will encourage decision makers in ministry of health to adopt PACS system in all new hospitals, also for private sector it will provide good benefit in their future plans to extend their adoption of new E-Health technologies.

5.6 Study limitations:

- The sample was not from all hospitals in Palestine, hospitals in Gaza were not included, and therefore generalization of results for all hospitals in Palestine is not acceptable.
- May some participants answers were to appear more favorable that led to study bias.
- It’s difficult to determine the actual variables that influence one another in the cross-sectional studies.
- It is difficult to involve other departments to the study such as radiology departments, orthopedic words, ICU words because it need long time to collect data from all hospitals.

5.7 **Future work**

The researcher recommends conducting a study on the impact of PACS system and the user's acceptance in future to other hospital departments such as ICU, Pediatric ward, orthopedic department and other hospital departments.

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Appendices

Appendix A- 1: questionnaire (Arabic)

Arab American University
Faculty of Graduate Studies
Health Informatics

الجامعة العربية الامريكية
كلية الدراسات العليا
المعلوماتية الصحية

كلية الدراسات العليا / المعلوماتية الصحية

استبانة بحث علمي

تحية طيبة وبعد.....

يقوم الباحث بإجراء دراسة حول تأثير نظام أرشفة الصور والاتصالات (PACS) على أقسام الطوارئ في المستشفيات الحكومية الفلسطينية وذلك كجزء من رسالة الماجستير في تخصص المعلوماتية الصحية من الجامعة العربية الأمريكية.

لقد حصل الباحث على إذن من وزارة الصحة لتوزيع الاستبيان.

سيكون الباحث ممتنا لك /ي إذا أجبت على أسئلة هذا الاستبيان، مع الاحتفاظ بحقك في عدم الإجابة على أي سؤال لا تريد الإجابة عليه، علما انه لا يجوز للباحث استخدام هذه البيانات إلا لأغراض البحث العلمي.

يرجى قراءة التعليمات المرتبطة بكل قسم وكل سؤال بعناية، سيتم التعامل مع ردودك على الأسئلة المطلوبة في هذا الاستبيان بسرية تامة ومطلقة، ولن تكون ردودك معروفة لأي شخص خارج فريق البحث، ولن يتم الكشف عنها لأي شخص داخل مؤسستك الصحية، ولن يتم طلب أي معلومة في الاستبيان تحدد هويتك وهي لغرض البحث العلمي فقط.

إذا كان لديك أي استفسار آخر حول الاستبيان يرجى التواصل مع الطالب حسب المعلومات أدناه:

الطالب: صالح ذياب

جوال:٠٥٩٨١٢٤٥٣٥

وطنية:٠٥٦٢٤٠١٢١٥

بريد الكتروني: salehthiab1987@gmail.com

المشرف: د. علي ابو عرة

شاكرين لكم حسن تعاونكم

Impact of Picture Archiving and Communication System (PACS) on Emergency Departments in Palestinian Governmental Hospitals

تأثير نظام أرشفة الصور والاتصالات (PACS) على أقسام الطوارئ في المستشفيات الحكومية الفلسطينية

القسم الاول: البيانات الشخصية

١. الجنس ☐ ذكر ☐ انثى

٢. العمر ☐ ٢٢-٣٠ ☐ ٣١-٣٩ ☐ ٤٠-٤٩ ☐ ≤ ٥٠

٣. طبيعة العمل ☐ استشاري ☐ اخصائي
☐ مقيم ☐ غير ذلك

٤. الخبرة مع نظام PACS ☐اقل من سنة ☐من سنة الى سنتين ☐اكثر من ثلاث سنوات

٥. استخدام PACS ☐ دائما ☐ مرارا ☐ سابقا لكن ليس الان

القسم الثاني:

١. قياس مدى الفائدة

الرقم	العبارة	غير موافق بشدة	غير موافق	محايد	موافق	موافق بشدة
١	يتيح لي استخدام نظام PACS إنجاز المهام بسرعة أكبر.					
٢	أدى استخدام نظام PACS إلى تحسين جودة عملي في تقديم رعاية أفضل للمرضى.					
٣	أدى استخدام نظام PACS إلى زيادة إنتاجيتي.					
٤	لقد عزز استخدام نظام PACS من فعاليتي في الوظيفة.					
٥	لقد جعل استخدام نظام PACS وظيفتي أسهل في الأداء.					
٦	لقد منحني استخدام نظام PACS تحكمًا أكبر في جدول عملي.					

٢. قياس مدى سهولة استخدام النظام

الرقم	العبارة	غير موافق بشدة	غير موافق	محايد	موافق	موافق بشدة
١	لقد كان تعلم استخدام PACS سهلاً بالنسبة لي.					
٢	كان تفاعلي مع PACS واضحًا.					
٣	كان تفاعلي مع PACS مفهومًا.					
٤	من السهل أن تصبح ماهرًا في استخدام نظام PACS.					

٣. قياس التغير

الرقم	العبارة					
١	كيف	اكثر صعوبة	صعب	محايد	سهل	اكثر سهولة
		☐	☐	☐	☐	☐
٢	جعل	غير مثير للاهتمام	اقل اثارة للاهتام	محايد	مثير للاهتمام	اكثر اثارة للاهتام
		☐	☐	☐	☐	☐
٣	نظام	مرهق بشدة	اكثر ارهاقا	محايد	مرهق	اقل ارهاقا
	PACS	☐	☐	☐	☐	☐
٤	عملك	اقل متعة بشدة	اقل متعة	محايد	ممتع	اكثر متعة
		☐	☐	☐	☐	☐

٤. قياس السلوك (القبول)

الرقم	العبارة	غير موافق بشدة	غير موافق	محايد	موافق	موافق بشدة
١	نظام PACS مثير للإعجاب وأنا أحبه.					
٢	من الصعب تعلم كيفية استخدام PACS.					
٣	غالبًا ما يكون استخدام PACS مزعجًا واشكو من استخدامه.					
٤	يتطلب استخدام PACS مستوى عال من الكفاءة.					
٥	هناك نقص في التعاون بين الموظفين عند استخدام PACS.					
٦	نادرًا ما أخطئ أو أرتكب خطأ أثناء استخدام PACS.					
٧	نظام PACS يبطئ أداء العمل.					
٨	أنا أستمتع بالعمل على نظام PACS.					
٩	أنا أفضل PACS على النظام التقليدي للطباعة الورقية والطباعة على الأفلام.					
١٠	أوصي باستخدام PACS لأقسام الطوارئ الأخرى.					

Appendix A -2: questionnaire (English)

Arab American University
Faculty of Graduate Studies
Health Informatics

الجامعة العربية الامريكية
كلية الدراسات العليا
المعلوماتية الصحية

Greetings,

The researcher conducts a study about Impact of Picture Archiving and Communication System (PACS) on Emergency Departments in Palestinian Governmental Hospitals. as part of the master thesis in Health Informatics from the Arab American University.

The researcher obtained permission from the Ministry of Health to distribute the questionnaire.

The researcher will be grateful to you if you answer the questions of this questionnaire, while reserving your right not to answer any question that you do not want to answer, noting that it is not permissible for the researcher to use this data except for the purposes of scientific research.

Please read the instructions related to each section and each question carefully, your responses to the questions requested in this questionnaire will be treated with complete and absolute confidentiality, and your responses will not be known to anyone outside the research team, and they will not be disclosed to anyone within your health institution, and no information will be requested in the questionnaire determines your identity and is for scientific research purposes only.

If you have any other questions about the questionnaire, please contact the student according to the information below:

Student: Saleh Thiab

Mobile: 0598124535/ 0562401215

Email: salehthiab1987@gmail.com

Supervisor: Dr. Ali Abu Arra

THANK YOU FOR YOUR KIND COOPERATION

Questionnaire

Impact of Picture Archiving and Communication System (PACS) on Emergency Departments in Palestinian Governmental Hospitals

Part One: Demographic Characteristics

1- Gender ☐ **Male** ☐ **Female**

2- Age ☐ **22-30** ☐ **31-39** ☐ **40-49** ☐ **≥ 50**

3- Job Title ☐ **Consultant** ☐ **Specialist**

☐ **Resident** ☐ **Others**

4- PACS Experience ☐ **< One year** ☐ **1-2 Year** ☐ **≥ 3**

5- Use PACS ☐ **Always** ☐ **Frequently**

☐ **In the past but not now**

Part Two:

1. Measuring Perceived Usefulness

No	statement	strongly disagree	disagree	neither agree/disagree	agree	strongly agree
1	Using PACS enables me to accomplish tasks more quickly.					
2	Using PACS has improved the quality of my work in providing better patient care.					
3	Using PACS has increased my productivity.					
4	Using PACS has enhanced my effectiveness on the job.					
5	Using PACS has made my job easier to perform.					
6	Using PACS has given me greater control over my work schedule.					

2. Measuring Perceived Ease of Use

No	statement	strongly disagree	disagree	neither agree/disagre	agree	strongly agree
1	Learning to use the PACS has been easy for me.					
2	My interaction with the PACS has been clear.					
3	My interaction with the PACS has been understandable.					
4	It is easy to become skillful at using the PACS.					

3. Measuring Change

No	Statement	Scale				
1	How has the PACS made your job	More difficult ☐	Difficult ☐	Neutral ☐	Easy ☐	Easier ☐
2		Not interesting ☐	less interesting ☐	Neutral ☐	Interesting ☐	More interesting ☐
3		Extremely more stressful ☐	More stressful ☐	Neutral ☐	Stressful ☐	Less stressful ☐
4		Extremely less pleasant ☐	less pleasant ☐	Neutral ☐	Pleasant ☐	More pleasant ☐

4. Measuring Behavior (Acceptance)

No	statement	strongly disagree	disagree	neither agree/disagree	agree	strongly agree
1	PACS system is admirable and I like it.					
2	It is difficult to learn how to use PACS.					
3	Use PACS is often annoying and results in my complaining about it.					
4	Use of PACS requires a high level of proficiency.					
5	There is a lack of cooperation among the personnel when using PACS.					
6	I rarely make a mistake or commit an error while using PACS.					
7	The PACS slows my work performance.					
8	I enjoy working on the PACS.					
9	I prefer PACS to the traditional system of paper-based and film-based printing.					
10	I recommend using PACS to other emergency departments.					

Appendix B: AAUP Approval

Arab American University
Faculty of Graduate Studies

الجامعة العربية الأمريكية
كلية الدراسات العليا

2021-4-6

الى من يهمه الامر،

تسهيل مهمة بحثية

تحية طيبة وبعد،

تهديكم كلية الدراسات العليا في الجامعة العربية الامريكية اطيب التحيات، وبالإشارة الى الموضوع أعلاه، تشهد كلية الدراسات العليا في الجامعة أن الطالب **صالح محمود صالح نياب** والذي يحمل الرقم الجامعي 201820308 هو طالب ماجستير في الجامعة العربية الامريكية تخصص معلوماية صحية ويعمل على اعداد رسالة الماجستير كأحد متطلبات الحصول على درجة الماجستير بعنوان:

" تأثير نظام أرشفة الصور والاتصالات (PACS)على أقسام الطوارئ في المستشفيات الحكومية الفلسطينية" تحت اشراف دكتور علي أبو عرة، نأمل من حضرتكم الايعاز لمن يلزم لمساعدته للحصول على المعلومات اللازمة للدراسة، علماً ان المعلومات ستستخدم لغاية البحث فقط وبسرية تامة، وقد أعطي هذه الرسالة بناءً على طلبه.

وتفضلوا بقبول فائق الاحترام،،،

د. اشرف الميمي

عميد كلية الدراسات العليا

كلية الدراسات العليا
FACULTY OF GRADUATE STUDIES

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E-mail: FGS@aaup.edu ; PGS@aaup.edu Website: www.aaup.edu

Appendix C: MOH Approval

State of Palestine
Ministry of Health
General Directorate of Education in
Health and Scientific Research

دولة فلسطين
وزارة الصحة
الإدارة العامة للتعليم الصحي
والبحث العلمي

Ref.: .....
Date:.....

الرقم: عخ/٥٧٩/٢٠٢١
التاريخ: ١٥/٤/٢٠٢١

الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،
الأخ مدير مجمع فلسطين الطبي المحترم،،،
تحية واحترام،،،

الموضـــوع: تسهيل مهمة بحث

يرجى التكرم بتسهيل مهمة الطالب: **صالح محمود صالح ذياب، ماجستير معلومات صحية– الجامعة العربية الامريكية**، لعمل بحث بعنوان:

"تأثير نظام أرشفة الصور والاتصالات (PACS) على أقسام الطوارئ في المستشفيات الحكومية الفلسطينية"

حيث سيقوم الطالب بجمع معلومات من خلال تعبئة استبانة من أطباء أقسام الطوارئ (بعد أخذ موافقتهم)، مع العلم أن مشرف الدراسة: د. علي ابو عرة.

وذلك في: **جميع المستشفيات الحكومية**

- **مجمع فلسطين الطبي**

على أن يتم الالتزام بجميع تعليمات وإجراءات الوقاية الصادرة عن وزارة الصحة بخصوص جائحة كورونا، وتحت طائلة المسؤولية.

على ان يتم تزويدنا بنسخة من نتائج البحث والتعهد بعدم النشر.

مع الاحترام،،،

د. عبد الله القواسمي
مدير التعليم الصحي والبحث العلمي

نسخة: مشرف الدراسة المحترم

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Appendix D: referees of the questionnaire

Name	Title	Location
Dr. Ali Abu Arra	Supervisor	An-Najah University
Dr. Mahmoud Alawneh	Radiologist	Rafidia Hospital - MOH
Mr. Zahi Hwary	Medical Imaging Technologist	Radiology Department Manager-MOH
Mr. Mohamad Salah Aldein	Computer Engineer	PACS Team -MOH
Mr. Jehad Abu Alrob	Medical Imaging Technologist	Radiology Department Head Section-MOH

ملخص الدراسة

مقدمة

تم اعتماد نظام أرشفة الصور والاتصالات مؤخرًا في المستشفيات الحكومية في فلسطين ، ويعتبر نظام أرشفة الصور والاتصالات أحد أهم تقنيات الرعاية الصحية الحديثة التي تعمل على تحسين الرعاية الصحية للمرضى ، مما يسمح بتخزين الصور الطبية واسترجاعها ونقلها وعرضها في العديد من مواقع المستشفيات أو النظام الصحي.

في الدول العربية ، عدد دراساتها صغير جدًا وفي فلسطين هي الدراسة الأولى التي تقيس مستوى قبول نظام أرشفة الصور والاتصالات ، باستخدام نموذج قبول التكنولوجيا TAM ، يتم التحقيق في تأثير نظام أرشفة الصور والاتصالات في أقسام الطوارئ في المستشفيات الحكومية على مستوى قبول المستخدم لنظام أرشفة الصور والاتصالات. حتى أفضل أنظمة تكنولوجيا المعلومات وأكثرها تكلفة ستصبح غير فعالة إذا قاوم مستخدموها ذلك ، وبالتالي فإن قبول المستخدم مهم لنجاح تطبيقات نظام أرشفة الصور والاتصالات في مؤسسات الرعاية الصحية.

الغرض من الدراسة

الغرض من هذه الدراسة هو تقييم "تأثير نظام أرشفة الصور والاتصالات (PACS) على أقسام الطوارئ في المستشفيات الحكومية الفلسطينية".

طرق الدراسة

كانت الدراسة عبارة عن تصميم مقطعي وصفي ، تم تضمين اثني عشر مستشفى حكوميًا في الضفة الغربية / فلسطين في الدراسة ، وقد شارك في الدراسة جميع الأطباء الذين يعملون في أقسام الطوارئ وهم حوالي ١٦٠ طبيبًا ، والدراسة كمية ومسحية لتصورات والمواقف والسلوكيات للمستخدم (الأطباء) تجاه استخدام نظام أرشفة الصور والاتصالات باستخدام استبيان. تم تحليل البيانات باستخدام الإصدار ٢٠ من حزمة IBM الإحصائية للعلوم الاجتماعية (SPSS).

النتائج

تم استكمال مائة وخمسة وثلاثين استبانة من أصل ١٦٠ استبانة وإعادتها إلى الباحث (نسبة الاستجابة ٨٤.٣٧٪). أظهرت النتائج أن استخدام نظام أرشفة الصور والاتصالات قد جعل عمل الأطباء أسهل في الأداء (المتوسط = ٤.٢٠) ، باستخدام نظام أرشفة الصور والاتصالات تمكن من إنجاز المهام بسرعة أكبر (المتوسط = ٤.١٩) ، وقد أدى استخدام نظام أرشفة الصور والاتصالات إلى تحسين جودة العمل في توفير رعاية أفضل للمرضى (يعني = ٤.١٩) ، كان تعلم استخدام النظام سهلاً (المتوسط = ٤.١٠) ، جعل النظام الأطباء يمارسون أقل إجهادًا وسهلاً وممتعًا وممتعًا ، ويوصي باستخدام نظام أرشفة الصور والاتصالات لأقسام الطوارئ الأخرى (يعني = ٤.٣٩). كما أظهرت الإحصائيات الوصفية أن مستوى القبول الكلي كان من الدرجة المتوسطة بمتوسط ٣.١١٧٩ ، وأظهر تحليل الارتباط أن هناك دلالة إحصائية موجبة بين PU و PEU والتغير كمجموع درجات وقبول ، وأظهر الانحدار المتعدد أن العامل الأكثر تأثيراً هو عامل التغيير. أظهر اختبار ANOVA أنه لا يوجد تأثير على القبول العام من المتغيرات الاجتماعية والديموغرافية.

الاستنتاج

تم استخدام نموذج قبول التكنولوجيا TAM لتقييم تأثير نظام أرشفة الصور والاتصالات على أقسام الطوارئ وقياس قبول المستخدم لهذا النظام ، ويعتبر قبول المستخدم عاملاً مهمًا في نجاح اعتماد تكنولوجيا المعلومات الخاصة بالرعاية الصحية وتنفيذها.

ونتيجة لذلك ، يوصى باستخدام نظام أرشفة الصور والاتصالات من وجهة نظر أطباء الطوارئ. كان مستوى القبول العام من الدرجة المتوسطة ، وكان عامل التغيير هو العامل الأكثر تأثيراً ، وجعلت نظام أرشفة الصور والاتصالات الأطباء يمارسون عملهم بأقل إجهادًا وسهلاً وممتعًا ، ويعتبرون أنه نظام سهل الاستخدام ويحسن جودة عملهم مما يؤدي إلى تحسين رعاية المرضى.

أخيرًا ، فإن تأثير نظام أرشفة الصور والاتصالات على ممارسة العمل في أقسام الطوارئ له تأثير إيجابي ويؤكد أن تحسين الرعاية الصحية للمرضى بشكل عام.