A CASE STUDY OF HEALTH INFORMATION SYSTEM WORKFLOW ON MITIGATING OPIOID DRUG ABUSE IN SAUDI ARABIA'S HEALTHCARE SYSTEM

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FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY UNIVERSITI MALAYA KUALA LUMPUR

2021

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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY UNIVERSITI MALAYA KUALA LUMPUR

0202

UNIVERSITI MALAYA ORIGINAL LITERARY WORK DECLARATION

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Name of Degree: **Doctor of Philosophy (PhD)**

Title of Thesis: A CASE STUDY OF HEALTH INFORMATION SYSTEM WORKFLOW ON MITIGATING OPIOID DRUG ABUSE IN SAUDI ARABIA'S HEALTHCARE SYSTEM

Field of Study: HEALTH INFORMATION SYSTEMS (HEALTH INFORMATICS)

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A Case Study of Health Information System Workflow on Mitigating Opioid Drug Abuse in Saudi Arabia's Healthcare System

ABSTRACT

The hospitals in Saudi Arabia, which have been studied in this research, are almost entirely automated. Healthcare information systems (HIS) are quite efficient; however, the health information exchange (HIE) is absent in the existing systems for different hospitals. Opioid drugs are an addictive substance, Saudi Arabia has the highest mean of drug abuse disorders in the region (680.5, group mean was 401.8). The lack of HIE had contributed significantly to the increase of opioid drug abuse in Saudi Arabia. If a patient has taken opioid as a painkiller, an interoperable system must have the information available for the healthcare department all over Saudi Arabia. Currently, this is not happening, and the HIE is limited. Authorization by the patient is one of the biggest challenges in HIE, as authorization is important to exchange health data through various technology and healthcare platforms. It may also lead to legal risks if the health information of the patient is shared without the patient's authorization. In response to the growing requirement of interoperability in healthcare system, this research aims to propose an interoperable and integrated HIS workflow processes that capable in mitigating abuse issues in Saudi Arabia. This study explored the magnitude of the opioid abuse issues in Saudi Arabia within the context of improper HIS design to identify abuse patients. Objectives associated with this research have been achieved using a qualitative approach with a case study research design. First stage was the observation conducted on sites to understand the practice of HIS workflow and how participants are using the currents HIS model. The primary data was collected through questionnaires that were filled out by the pharmacists and physicians. Interviews were also conducted with the physicians and pharmacists. Some secondary data has also been used in developing responses to the research questions. This research has also identified the current workflow processes of prescribing opioid drugs using HIS in Saudi Arabia while exploring physician and pharmacist perception on the usage of current HIS model regarding opioid drug abuse. Primary data collected from the physicians and pharmacists involved in the field has shown that they are aware of the existing situation that prevails in Saudi Arabia regarding the abuse of opioids. The suggested system workflow processes provide coordination of various sections of the healthcare industry in a manner that makes tracing opioid abuse possible. E-prescription is vital tool in this regard. Interoperability is the key to resolving this issue. At the end of this research, validation of the improved HIS workflow process is done by exploring participants' and experts' impressions on the proposed interoperable HIS workflow processes. For this purpose, information was collected from the participants, field experts, and IT professionals. The participants and healthcare experts have reviewed the proposed system and considered as valid for hospitals in Saudi Arabia. The IT experts also believe that such an interoperable system can work very well in Saudi Arabian hospitals. This study is a steppingstone for future research, which can help in overcoming drug abuse and misuse issue in Saudi Arabia. The same proposed HIS workflow processes can be applied in other countries to help control the drug abuse issues all over the world.

Keywords: Opioid abuse, Health Information Systems, PDMP, Interoperability, Saudi Arabia.

Kajian Kes Aliran Kerja Sistem Maklumat Kesihatan bagi Pengurangan Penyalahgunaan Dadah Opioid dalam Sistem Penjagaan Kesihatan Arab Saudi.

ABSTRAK

Hospital-hospital di Arab Saudi, yang dikaji dalam kajian ini, hampir sepenuhnya automatik. Walaupun sistem aliran maklumat penjagaan kesihatan (HIS) cukup cekap, namun pertukaran maklumat kesihatan (HIE) tidak wujud dalam sistem sedia ada untuk hospital yang berlainan. Ubat opioid adalah bahan ketagihan, Arab Saudi mempunyai gangguan penyalahgunaan dadah tertinggi di rantau ini (680.5, min kumpulan adalah 401.8). Kekurangan HIE telah menyumbang secara signifikan kepada peningkatan penyalahgunaan dadah opioid di Arab Saudi. Sekiranya pesakit telah mengambil opioid sebagai ubat penahan sakit, sistem yang saling beroperasi mesti mempunyai maklumat yang tersedia untuk jabatan kesihatan di seluruh Arab Saudi. Pada masa ini, ia tidak berlaku, dan HIE adalah terhad. Kebenaran oleh pesakit adalah salah satu cabaran terbesar di HIE, kerana kebenaran adalah penting untuk menukar data kesihatan melalui pelbagai teknologi dan platform penjagaan kesihatan. Ia juga boleh menyebabkan risiko undangundang jika maklumat kesihatan pesakit dikongsi tanpa kebenaran pesakit. Sebagai tindak balas terhadap keperluan saling beroperasi dalam penjagaan kesihatan yang semakin meningkat, tujuan kajian ini adalah untuk mencadangkan proses aliran kerja HIS yang saling beroperasi dan bersepadu yang berupaya mengurangkan isu penyalahgunaan di Arab Saudi. Kajian ini meneroka besarnya isu penyalahgunaan opioid di Arab Saudi dalam konteks reka bentuk HIS yang tidak betul untuk mengenal pasti pesakit yang mengalami penyalahgunaan. Objektif yang berkaitan dengan penyelidikan ini telah dicapai dengan menggunakan pendekatan kualitatif dengan reka bentuk kajian kes. Tahap pertama ialah pemerhatian yang dilakukan di lokasi untuk memahami amalan aliran kerja HIS dan bagaimana responden menggunakan model HIS semasa. Data primer telah dikumpul melalui soal selidik yang diisi oleh ahli farmasi dan doktor. Temu ramah juga telah dijalankan dengan doktor dan ahli farmasi. Beberapa data sekunder juga telah digunakan dalam membangunkan maklumbalas terhadap soalan kajian. Kajian ini juga telah mengenal pasti proses aliran kerja semasa dalam menetapkan ubat opioid menggunakan HIS di Arab Saudi sambil meneroka persepsi doktor dan ahli farmasi mengenai penggunaan model HIS mengenai penyalahgunaan dadah opioid. Data primer yang dikumpulkan dari doktor dan ahli farmasi yang terlibat dalam kerja lapangan menunjukkan bahawa mereka menyedari situasi semasa yang ada di Arab Saudi berkenaan dengan penyalahgunaan opioid. Proses aliran kerja sistem yang dicadangkan meyediakan koordinasi pelbagai bahagian dalam industri penjagaan kesihatan dengan cara yang memungkinkan pengesanan penyalahgunaan opioid. E-preskripsi adalah alat penting dalam hal ini. Saling beroperasi adalah kunci untuk menyelesaikan isu ini. Pada akhir kajian ini, pengesahan proses aliran kerja HIS yang ditambahbaik dilakukan dengan meneroka kesan kepada responde dan pakar mengenai proses aliran kerja HIS yang dicadangkan. Untuk tujuan ini, maklumat dikumpulkan dari responden, pakar bidang, dan profesional IT. Para responden dan pakar kesihatan telah mengkaji sistem yang dicadangkan dan dianggap sah untuk hospital di Arab Saudi. Pakar IT juga percaya bahawa sistem yang dapat dikendalikan dapat berfungsi dengan baik di hospital Arab Saudi. Kajian ini merupakan batu loncatan untuk kajian pada masa depan yang dapat membantu mengatasi masalah penyalahgunaan dadah di Arab Saudi. Proses aliran kerja HIS sama yang dicadangkan dapat diterapkan di negara lain untuk membantu mengawal isu penyalahgunaan dadah di seluruh dunia.

Kata kunci: Penyalahgunaan opioid, Sistem Maklumat Kesihatan, PDMP, Saling beroperasi, Arab Saudi.

ACKNOWLEDGEMENT

First and foremost, thank to Almighty Allah for His grace in successfully completing my research work.

I would like to convey my intense and earnest appreciation to my respected supervisors, Dr. Norjihan Abdul Ghani, and Dr. Nordiana binti Ahmad Kharman Shah to give me the opportunity and facility to work under their invaluable guidance, to conduct my research, and provide invaluable and insightful suggestions and advice throughout the research. Their vision, honesty, and motivation have strongly helped me achieve my goals. It was a wonderful privilege and respect to work and study under their direct supervision.

No words are enough to express my heartfelt gratitude to my late mother for her love, prayers and caring from the day I started this research, but unfortunately, I lost her before the end of this successful journey. I am very much thankful to my beloved wife and my lovely kids for their unconditional love, understanding, patience, sacrifices, and consistent support to complete my research. I also would like to convey big thanks to my adorable sisters, brothers, for their harmonious support and prayers.

My special thanks go to the Universiti Malaya to give me the opportunity to conduct my research in a unique scientific community, this extends to the most knowledgeable staffs of the FCSIT. I am also very thankful to my friends and colleagues for their enthusiastic support for all the time.

Finally, I want to gift this work conducted to the soul of my parents who always cared, supported, and believed on me. They did their best to invest on me for my success. So many thanks Dad, many thanks Mom. Rest in peace.

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LIST OF SYMBOLS AND ABBREVIATIONS

DDD	:	Defined Daily Doses
EHR	:	Electronic Health Record
FARS	:	Fatality Analysis Reporting System
FDS	:	Formulary Decision Support
HIE	:	Health Information Exchange
HIIF	:	Health Information Integration Framework
HIPAA	:	Health Insurance Portability and Accountability Act
HIS	:	Health Information System
I-STOP	:	Internet System for Tracking Over-Prescribing
IETF	:	Internet Engineering Task Force
KFSHRC	:	King Faisal Specialist Hospital & Research Center
OA-MAT	:	Opioid Agonist Medical Assisted Treatments
ONDCP	:	Office of National Drug Control Policy
PDMP	:	Prescription Drug Monitoring Programs
PHCS	:	Participating Health Care Subscribers
PHI	÷	Personal Health Information
POA	÷	Prescription Opioid Analgesics
RMC	:	Research Management Center
SAMHSA	:	Substance Abuse and Mental Health Service Administration
TLS	:	Transport Layer Security
UM	:	Universiti Malaya

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CHAPTER 1: INTRODUCTION

1.1 Preamble

Effective strategies are required to reverse the trends and improve population health and wellbeing. Recently, multiple health organizations have adopted different electronic prescription drug monitoring systems to better monitor and control the drug dispensing patterns. Health information technology systems such as prescription drug monitoring program (PDMP), DrFirst Software, Internet System for Tracking Over-Prescribing (I-STOP), The Kansas Tracking and Reporting of Controlled Substances system (K-TRACS), are advisable to monitor drug abuse and take part in preventing death and decrease abuse of medical resources (Gugelmann *et al.*, 2012; Haegerich, 2014; Hagemeier *et al.*, 2014).

Opioids, also known as opiates, are narcotic painkillers used for both acute and chronic pain management. Misuse and abuse of other controlled substances, as well as the use of opioids as disorders, are significant public health problems. Opioid overdose deaths have been on the rise since the early 1990's and are one of the leading causes of injury deaths in the United States. (Haegerich *et al.*, 2014). It is reported that drug abuse is increased among Saudi Arabian young person's using illicit substances, but little is known about the frequency with which they occur (Alibrahim *et al.*, 2012; Saquib *et al.*, 2020).

Missing a real times information about a patient medication's history would increase the chances of abuse and overdose of opioids by making the wrong decision by health care providers (Simon, Benjamin, Delano, & Bates, 2009). There is lack of a systematic medication information system in Saudi Arabia which magnifies the issue of drug abuse, addiction, and misuse (Aljadhey *et al.*, 2015; Saquib *et al.*, 2020).

Health information exchange (HIE) is the transfer of patient's health information among different organizations within a region, community, or hospital system electronically. Nurses, doctors, pharmacists, and other medical practitioners can share and access important and crucial medical information about their patients (Menamechi & Singh, 2012). Information exchange in a healthcare information system is crucial for patients, doctors, and healthcare organization as information exchange among multiple different organizational HIS enhances the efficiency and effectiveness of health care services provided (Menamechi & Singh, 2012; Noumeir, 2012; Esmaeilzadeh, 2020).

The system is not successfully employed in Saudi Arabia among various HIS to improve the control of opioid dispensation (Alblooshi *et al.*, 2016; Aljadhey, *et al.*, 2015). Hence, this thesis proposes an enhanced workflow process model to enhance the information exchange to offer a real time information exchange and participate in curbing abuse and misuse of controlled substances such as opioids. This study will focus on investigating the current information system processes and optimizing the use of information technology sharing processes (interoperability) among health care facilities to enhance patient care, monitor care providers, and patient's behavior to mitigate the epidemic of Opioids abuse and misuse.

1.2 The Background of the Research Problem

Prescription Drug Monitoring Systems is a popular and widely used system to monitor prescription drugs dispensation. It mainly addresses opioids and other controlled drug related health problems (CDC, 2016). Opioids and other substances abuse are public health issue in many countries including Saudi Arabia that have led to mental, occupational, and financial consequences (Bassiony, 2013; McHugh, Nielsen, & Weiss, 2015; Alahmari, Ashworth, & Alkhalaf, 2019). The existence of scattered HIS's and the

lack of standardized healthcare terminology worked as the barriers to achieve HIS integration which worsen the case (Aljadhey *et al.*, 2015; Rutkow *et al.*, 2015). Important information stored in individual data systems can present a clear and complete picture of the patient when integrated using multiple HIS interactions.

1.2.1 Controlled Substances Abuse in Saudi Arabia

Patients suffering from different chronic diseases including various forms of cancer and those involved in accidents have benefited in reducing pain due to the adoption of opioids in the management of their pain. Given that some of the chronic diseases may not be cured, the patients face a lifetime of pain if such prescriptions are not provided (Abdulla *et al.*, 2013; Manglik *et al.*, 2016). A recent report by WHO (2018) reported an increased death rate from drug use in Saudi Arabia by 1.24 per 100,000. According to Aljaser (2013) it was 0.06 per 100.000. Consequently, the regulation of opioids has become an important goal of health care agencies in all parts of the world including Saudi Arabia. While the drugs can reduce patient's experience of pain, their distribution in the market must be restricted to avoid abuse (Wallwork, Chipidza, & Stern, 2016). Physical dependence on opioids means that the patients experience severe withdrawal symptoms in addition to being at risk of overdose-related deaths (Brady, Wunsch, DiMaggio, Lang, BGiglio, & Li, 2014; Leece *et al.*, 2015).

In Saudi Arabia, the ministry of health is responsible for providing guidelines to govern the control of distribution, prescription, dispensing, storing, and disposing of controlled substances and narcotics (Eid, Manias, Bucknall, & Almazrooa, 2014). To achieve this, Saudi Arabia's ministry of health has defined the responsibilities of various hospital personnel who handle the drugs across different stages of distribution. In addition to that, national center for health information in Saudi Arabia had set a group of policies to regulate the HIE among different health care organizations to control such an epidemic, once the unified electronic medical record is in live.

1.2.2 HISs and Electronic Health Records

An Electronic Health Record (EHR) or HIS is a patient's medical history that is in an electronic form and is maintained by the service care provider to improve efficiency and decision-making (Ben-Assuli, Shabtai, & Leshno, 2013). EHR carries patient's past health history, diagnosis, medication and treatment plans, allergies, immunization status, and laboratory test results. It has enhanced electronic ordering and improved decision making on the clinical support system (King, Patel, Jamoom, & Furukawa, 2014). HIS has benefits to the patients and the organization. To begin with, they increase patient's safety and reduces medical errors (Hydari, Telang, & Marella, 2015).

Secondly, EHR or HISs enhance the availability of information among nurses, doctors, care providers, and patients. The information can be accessed anytime when it is needed. EHRs provide complete, reliable information about patient's medical history leading to better outcomes. Proper decisions are made through alerts and reminders (Car, Huang, Sloot, & Franklin 2017). Through E-prescribing, patients and care providers will enjoy providing services and keep their health care commitments.

Additionally, EHR or HISs have enhanced care coordination due to intensified quick access to patient's record. Every care provider has the same accurate information about a patient and can do a follow up (Zhang, Pakhomov, Arsoniadis, Lee, Wang, & Melton, 2017). It is most important and recommended for patients seeing multiple practitioners. Those who are changing care settings, receiving emergency treatments. Medical errors and double tests are in turn reduced (Narcisse, Kippenbrock, Odell, & Buron, 2013). EHR and HISs have led to improve quality and efficient health care (Campanella, Lovato, Marone, Fallacara, Mancuso, Ricciardi, & Specchia, 2015). HER is the fundamental tool

for a health organization to exchange patients medical and clinical information with other external health organizations.

1.2.3 Health Information Exchange

A health care provider can see the process of data transfer and access all reports from the laboratory as well as radiology. With this information, high quality of care is provided to patients (Simon, Benjamin, Delano, & Bates, 2009). In addition, there is a streamline of administrative roles resulting in the reduction of administration cost. Therefore, the facility management is saved from the tasks of handling written documents and facsimile (fax). Communication is accelerated among the administration because all necessary information is available to everyone (Peden, 2012).

HIE occupies patients with the necessary information. Patients are also involved in their medical life (Simon, Benjamin, Delano, & Bates, 2009). Patient's involvement in their health care is vital. The patient's time that could have been used in the filing of paperwork and giving his or her medical history to providers is also reduced (Silow-Carroll, Edwards, & Rodin, 2012). Interoperability involves data exchange and use of details that have been exchanged. Interoperability helps in removal of same records and increases the efficiency of the medical staff members (Barangiu, Dragoicea, & Novoa, 2016).

1.2.4 Current practice of Prescription Drug Monitoring systems

As a result, countries have developed and implemented prescription drug monitoring programs to monitor prescription of medicines. For instance, the United States developed multiple electronic monitoring programs such as the Prescription Drug Monitoring Programs (PDMPs), DrFirst Software, Internet System for Tracking Over-Prescribing (I-STOP), The Kansas Tracking, and Reporting of Controlled Substances system (K- TRACS) to address the health problems (CDC, 2016). PDMPs are the mostly used system in USA especially in big health care centers. They are electronic databases that monitor the information to identify drug abuse and diversion and provide pharmacists and healthcare providers with the necessary information concerning the patient's controlledsubstance prescription history (Hahn, 2011). Actions are taken when the patient attains the established threshold. Actions include, informing physicians to dispense medication to patients, limiting the number of pharmacies used by the client to one, and informing him or her of suspicious activity. Other actions are referring the patient to law enforcement agencies for investigation (Hahn, 2011).

According to Hildebran *et al.* (2014), there are differences in the use of prescription drug monitoring programs by clinicians and there is no pre-determined method of applying them to the healthcare workflow to make the results effective.

1.2.5 Integrating prescription monitoring systems with HIS

Although implementation process of PDMP's vary in different health care setting, Rutkow *et al.* (2015) recommends a strategy that can be used to help to minimize difficulties associated with data interpretation. Integrating education of PDMP in health care programs will help to influence the perception of the medical provider which will produce a positive result thus increasing access to data in different health care. Another way to eliminate this barrier is by integrating the PDMP with the Electronic HIS which most physicians are familiar to use. Electronic HIS, including electronic health records and electronic medical records, are critical to improve collection, storage, retrieval, and sharing of healthcare information to reduce drug and prescription errors and improve the quality of care offered to patients (Kumar, 2011). The information is used to make clinical decisions while providing treating to the patient and prevent drug overdose and misuse. Miss integration with organization HIS will delay the process of managing patient on arrival. One of the gaps identified earlier in different studies was that there was no integration enforcement with the organization HIS to benefit a real time information from the PDMP.

1.3 Problem Statement

Interoperability is a requirement for effective deployment of HISs such as prescription drug monitoring systems. Absence of interoperability is a barrier to the exchange of health information across hospitals because of the disintegration of the HIS (Noumeir, 2012). This results in opioid drug abuse not being well controlled, instead creating a critical population health problem. Lack of interoperability has denied access to some of the information needed for treatment, such as a history of opioid use from other healthcare facilities. Lack of interoperable prescribing drug monitoring system in Saudi Arabia as well as missing real time drug history information on patient arrival has prevented monitoring of prescription of opioid and other controlled substances and increased the probability of drug abuse and misuse. The current HIS process in Saudi Arabia does not provide the exchange of information on patient's use of opioids or control substances. This is one of the main problems that leads to the abuse of opioids and controlled substances. Moreover, HIS in Saudi Arabia remains within the same organization due to the lack of an interoperable HIS processes.

One of the major problems found in most of the literature was the integration of patient prescription drug histories with multiple HISs. It was identified as a serious gap in the current prescription drug monitoring system's performance. Loss of interdependence between different HISs leads to the drug abuse and consequently death among different patients. Healthcare providers do not have access to information on patient prescription history for opioids from various healthcare settings and are unable to make clinical decisions when instructed to avoid drug abuse. Therefore, current systems and existing workflow processes need to be enhanced to enable patient information exchange.

1.4 Research Objectives

The objectives of the research study are shown below:

- 1. To explore the magnitude of the opioid abuse issues in Saudi Arabia within the context of improper HIS design to identify abuse patients.
- To identify the current process on prescribing Opioid's drug using HIS in Saudi Arabia while exploring physician and pharmacist perception on the usage of current HIS regarding Opioids drug abuse.
- 3. To propose an enhancement of the current workflow processes of the HIS to mitigate opioid drug abuse issues.
- 4. To validate the proposed HIS workflow processes.

1.5 Research Questions

Based on the study objectives, the formulated research questions have been presented below:

- 1. What is the extent of opioid abuse in Saudi Arabia from a physician and pharmacist prospective in term of HIS usability to control abuse issue?
- 2. What are the current processes in prescribing Opioids drug using HIS in Saudi Arabia and what are the perceptions on the use of current HIS among physicians and pharmacists in Saudi Arabia?

- 3. How can a HIS participate in mitigating Opioid's abuse issues in Saudi health care system?
- 4. How do participants and HIS experts perceive the proposed workflow process compared to their current HIS practices?

1.6 Research Methodology

Research methodology contributes to the research development and works as a career map for the researcher. It also works and help in displaying the researcher's intellectual vision as well as critical thinking (Austin, 2006). This research is based on the use of SPSS software and thematic analysis as a research tool. SPSS will be used to analyze the questionnaire before the interview while thematic analysis will manage the interview results. The flow diagram of the research methodology is explained below.

The proposed research started with brainstorming to determine and define the research strategies to conduct. This identifies two sub subsections, HIS and Opioid abuse epidemic. These subsections are interrelated as HIS is used to control and monitor the abuse of opioids.

The above two subsections lead to next level subsections, which are: Interoperability of HIS and Prescription drug monitoring system. These two are also interrelated as interoperability of HIS will boost up the Prescription drug monitoring system.

After analyzing the four subsections and performing extensive literature reviews, problem statements are defined. Based on the defined problem statements, current processes on prescribing Opioid drug using HIS in Saudi Arabia are identified.

Uses of current HIS in curbing abuse issue in Saudi Arabia are analyzed through physicians and pharmacists' perceptions.

Next step of the study is divided into three: Qualitative study, Case study, and Instruments. The instrument has three subsections, Observation, Survey, and Interview, which are included in the research methodology. These three processes lead to data collection and analysis.

Results are identified through extensive analysis of the collected data. Results are also discussed in this stage of the study.

At this stage of the study, through the uses of literature study, analyzed data, and obtained results, enhanced workflow process of interoperable information system is designed and proposed to implement in Saudi Arabia.

Finally, conclusion, recommendation, and potential future research are discussed and suggested at this stage.

Figure 1.1 presents the flow diagram of the research design.



Figure 1.1: Research Execution Diagram

1.7 Scope of the Research

This research Investigates current information systems processes in use to prevent or curb opioid use throughout Saudi Arabia. Emphasis is placed on studying the current workflow process of the existing HIS's. Research seeks to provide insights in optimizing the use of information exchange processes (interoperability) among health care facilities HIS and enhancing workflow processes to improve the current prescription drug monitoring process, thus, to enhance patient care and safety.

Furthermore, this study proposes an enhanced workflow process of the existing HIS's to overcome the abuse issue of opioids and other substances. Since most of the hospitals in the kingdom of Saudi Arabia had adopted electronic HISs a long time ago, two large hospitals were selected to apply this study to get benefits from this type of patients and their recurrent visits. This study focuses on the physicians and pharmacists' experiences by using HIS as well as their perception of futuristic adoption of new proposed workflow processes in the two selected hospitals.

Physician and pharmacist were selected as participants because they all together form the cycle of ordering prescription (by physician) and dispensing (by pharmacists). So, both participate in completing the cycle, hence, their experiences and perceptions need to be combined and studied to form a better and complete understanding of the current process.

One of the selected hospitals is a tertiary care center called King Faisal Specialist Hospital and research center, the other one is a public mental complex that deal with drug addiction and psychiatric patients called AL AMAL Hospital. These two hospitals located in Riyadh city, the capital of Saudi Arabia, where most of the population resides. More information on the research conduction sites will be presented in the case study chapter.

1.8 Significance of the Study

The study is significant to healthcare providers, the larger society, and patients as it will improve the monitoring of the use of opioids/controlled substances prescriptions as well as managing such cases to mitigate abuse and misuse issues. The misuse and abuse of opioids has increased in the past years and adversely affected patients' health by causing opioid use disorders (Denisco et al., 2011). Disorders caused by opioid abuse are almost four times more common compared to disorders associated with the heroine. Alblooshi et al. (2015) noted the abuse of substances, including episodes in Arab countries, is a concern, and it affects society as substance abuse disorders cause a financial burden. Therefore, mandatory reporting of prescription drugs such as opioids is key to prevent the disorders by curbing the abuse of the drugs and deaths caused by an accidental overdose of opioids. The proposed interoperable prescription drug monitoring systems workflow can be implemented to gather data on controlled substances including opioids. The systems workflow process will help to collect information on the quantity of the medicine, dosage, name, prescription date, prescriber title, and date. The information will enable healthcare providers and pharmacists to identify persons who seek opioids from different healthcare providers and prevent them from getting multiple prescriptions of the drugs at the same time. The proposed information system workflow process will allow real-time sharing of patient information and prescribers will be able to check the patient's recent history before prescribing controlled substances (Alblooshi et al., 2016).

Also, this study will help to formulate better understanding of how interoperability could improve HIS through integration of prescription drugs monitoring systems and the organizational HIS. The research based on sharing of drug information between multiple organizational HIS and new innovative concepts to improve the efficacy of information exchange among different healthcare organizations.

1.9 Research Contribution

This study will expand the theoretical scope of opioids problem at many levels, including organization, academic, and research. Various stakeholders will find a valuable insight in developing and improving workflow processes of an interoperable drug monitoring information systems. This includes challenges and success factors of the whole journey.

This study will also contribute and enrich the information systems society by researching a vital topic that touch human wellbeing. Lack of research on drug monitoring information systems and the impact of health IT in identifying patients at risk of misuse and abuse of controlled substance was obviously noticed particularly in Saudi Arabia.

Another contribution of the research on opioid/narcotic abusers in relation to HIS is that it will acknowledge health practitioners about the needs of identifying and flagging repeated patients (Hamilton, 2009). As research indicates, this is an important step when dealing with opioids or controlled substances users because it paves way for practitioners dealing with such cases to come up with strategies that would help to deal with such cases more effectively (Hamilton, 2009). As a result, the research topic will play an important role in assisting healthcare practitioners in reducing the amount of time required for diagnosis and symptom monitoring when working with this group of patients (Penna, Jennifer, & Robert, 2016).

Additionally, the research will contribute to the safety of both the community and medical staff. This is because the HIS allowing for medical organizations to respond quickly to the arrival of repeat opioids or controlled substances users will help to secure the most violent of them based on the information stored in the systems about the reactions of such patients (Hamilton, 2009). In most cases, studies indicate that more than 61% of repeat opioid users turn violent by the time they are brought into health organizations for containment (Penna, Jennifer, & Robert, 2016). This therefore means that the research

will help make it safer for medical staff and friends or family members bringing in the patients.

This research aide the hospital system in providing various measures and tools that assist in the process of rehabilitation in opioid users as well as other strategic plans to mitigate such issues.

1.10 Organization of the Thesis

The organization of the chapters of this thesis is illustrated in graphical representation with detail of the chapter sequences and chapter contents.

Chapter 1	• It presents background of the study, also presents the progress and improvment of HIS technologies. It introduces the issue and the current practice of resolving the issue, health information exchange standards internationally and regionally. This chapter also contains the problem statement, research objectives, research questions, study significance, research scope, and research plan.
Chapter 2	• It explains and assesses the current status of monitoring substances misuse/abuse patients, explore the current HIS usability, review the on going practice of PDMP systesms, review health care technology interventions on resolving abuse issue. It also reviews researches experiences how to deal with such an issue, in addition to the gaps existing, and expected future requirements. It will elaborate the proposed IS model and its uniquness in contriling the epidemic.
Chapter 3	•This chapter includes research methodolgy, discusses research design, samples, ethicis, instruments used, participants involved and targeted, collected data in addition to the interviews activities that will take place, more elaboration and HIS readiness, information on hospitals participating in this study will be stated in thsi chapter as well.
Chapter 4	•This chapter will be a case study sites including the information on the two selected hospitals parlticipating in this study as it will introduce the two hospitals current practice to fight the misuse/abuse epidemic, HIS readiness and capabilities of health information exchange.
Chapter 5	•Chapter five includes the result and finding of the data analysis conducted. this include the questionnaire, interview questions as well as documents reviewed. All will be in realtion to the study objectives and reserach questions mentioned in Chapter 1.
Chapter 6	• This chapter will present the discussions on findings from results. It will detail a clear elaboration by researcher on findings, it will also include discussions on the validation outputs as well as the expected out comes of the proposed processes model.
Chapter 7	• This chapter presents summary of the entire study. It also proivdes the research limitations identified in addition to the future researches recommendations. This chapter ends with conclusion of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents relevant literatures reviewed in depth to illustrate and discuss previous studies related to the research topic. It had assisted the researcher to determine the magnitude and scope of the conducted study, and to identify significant gaps. This exercise helped research to draw the road map to point out the research problem, elaborate the previous practices on the topic to form the framework for enhancing the current practice to a better shape, resulting a promising output for health care organizations.

This chapter starts with a review of relevant studies on controlled substance abuse or misuse as an international epidemic with an overview of the issue in Saudi Arabia. It starts with a differentiation statement on the terms Abuse and Misuse for more clarity. Followed by a review of the efforts and guidelines set to control and fight this spreading epidemic. The section also presents an overview of the health care technology and its application as well as the implications. This section includes an introduction review to the revolutionary stages of electronic health records in early stages to reach the concepts of a wider HISs in addition to the electronic prescription (EP) which plays a vital role of a comprehensive HIS performance, in addition to pointing out the importance of integration among different HISs and challenges.

Next section introduces the theoretical framework applied in this research, which is in parallel to the technology acceptance among health care providers. Section (2.5) illustrates the reviews of studies on workflows and processes management, their types, tools, benefits of HIE process, its importance, interoperability concepts, and its involvement in health care systems. This also will cover the HIPAA's HIE guidelines and

policies governing the process of information exchange. This chapter concludes with a summary of reviewed literatures related to the study questions and concept of interoperability.

2.2 Technology and Health Care Trends

Technology and Information systems in health care settings have been acknowledged as an important step that enable the physicians to meet the increasing healthcare demands and support better patients care plan and delivery. Also, technology and information systems inform clinical decision making in health care organizations. According to studies, clinical documentation has been improved using HIS to access, exchange, and receipt the clinical data provided (Bardhan & Thouin, 2013; Zulman *et al.*, 2015). Technology and information system in health care delivery have supported better decision making with relation to patient care.

The problem with management of opioid use is that the drugs are sometimes widely available as prescription pain medication while the public is also poorly informed about issues such as safety and addictive nature (Alshammary, Abdullah, Duraisamy, & Anbar, 2014; Al-Zahrani, Eldali, & Al-Shahri, 2014; Isa & El-Sabbagh, 2014). The result of this trend is an upsurge in the nonmedical use of controlled substances with the health facilities having to deal with increased patient admissions due to the adverse effects of misusing prescription opioids (Gaferi, Osman, Matheson, Wanigaratne, & Bond, 2013). Consequently, the use of opioids possesses a challenge to physicians when diagnosing and treating pain syndromes due to the difficulty in identifying individuals with high risk of the addictive disorder.

E-prescribing also called electronic prescribing that is a part of the HIS is the system that allows doctors, nurses, and other medical practitioners to write and send patient's prescription to the pharmacist electronically (Parv, Kruus, Mõtte, & Ross, 2016).
Therefore, doctors and nurses will not do faxes, paperwork, or even call pharmacists to provide a prescription.

A good number of hospitals and pharmacies have started using the E-prescribing system. Numerous benefits to the organizations and patients who use the E-prescribing system have been witnessed. E-prescribing has improved the quality and efficiency of the prescribing process as opposed to paperwork. This is because the prescription is not written manually, and little time is required to explain electronic prescriptions. Moreover, physicians have enough information at the time of prescribing which reduces the number of follow up calls between doctor and pharmacist (Tolley, 2012). Medical errors are reduced because pharmacists do not have to interpret medical prescriptions (Gider, Ocak, & Top, 2015). E-prescribing reduces cost hence financial benefit goes to both the patients and the organizations. Patients do not have to keep visiting health care centers and emergency rooms.

According to studies, design of the HIS has enabled the clinicians to access and work with a variety of patient information. Through these technologies, the quality of health care has been promoted and improved due to the integration of a coordinated information exchange system (Waterson, 2014). The introduction and use of the HIS began in the 1980s to enable the physicians to store more generic information that had been extracted from the laboratory examination (Payne, Eden, Davison, & Bakker, 2017). The main purpose of the HIS in health care settings is to manage the information from all healthcare related activities and help the clinicians in making informed decisions.

Introduction and use of technology in patient care delivery have implications for health care providers. For instance, some of the technologies such as the e-visits, remote monitoring, and e-prescriptions have enabled some health care organizations to shift care in primary care clinics and hospitals to home care. Nonetheless, technology has also led to further improvements to different care settings such as the mental health care settings (Donker *et al.*, 2013; Hollis *et al.*, 2015; Marzano *et al.*, 2015). According to Price *et al.* (2014), the use of mHealth has enabled the care providers to assess and track the treatment process for the mental health patients.

The integration and development of technology and information systems in healthcare delivery are supported by global technology companies including Google and Apple Companies. Through the involvement of these global technology companies, the health organizations have been able to identify new healthcare provider models, and approaches that are designed to improve the quality of patients care in hospitals.

Several challenges are associated with the integration of technology and HISs in patient care delivery. One of the main challenges is security and privacy. Physicians deal with confidential and sensitive patient health data. Therefore, security must be one of the primary concerns in healthcare applications (Patel & Kannampallil, 2014; Sultan, 2015). According to Schwamm (2014), while designing compliant electronic health applications, they must consider security standards of the application for comprehensive data protection and access control.

Several privacy laws and regulations are associated with patient document rights especially how the information is shared by the providers when interoperability is initiated.

2.2.1 HIS and electronic health record

Information is vital in healthcare as it helps in enabling health providers to deliver health care efficiently. Information is gathered and processed by physicians and hospitals as they provide care for their patients. Good decision making in health care is enhanced by reliable and sound information. Therefore, HIS's are essential for monitoring and evaluation as well as the support of a health facility and their patients. HIS's have a capability to provide early warning of possible health problems in patients. Research can be supported by the systems while providing a foundation for global reporting on health challenges to various users.

HIS's provide tools for clinicians for decision making process. HIS contains four key functionalities: data generation, compilation analysis and synthesis, communication, and usability. The HIS helps in collecting data from health sector and other relevant organizations, analyses the data and ensure overall data quality, relevance and timelines, converting collected, analysed data into a meaningful health information that leads to a proper decision making action (WHO, 2008).

HIS are costly to implement as the automated systems are expensive. However, the cost of maintaining the manual system is higher in the long term. More staff members are required to manage the huge amounts of patients' records. As an institution grows and receives more patients' record filing, maintenance and archiving become a tedious job. The records also take up a lot of space which could be useful for other activities. Replacing the paper system with a digital one would mean having less staff, well organized workplace, and cutting on costs. Navigation of a paper-based system is another problem when certain records are required. HIS works on a coordinated platform where a record would be required in various areas like the lab or pharmacy. An automated system will give access to the same information at any given time. Decision making is made easy since all information about a patient is stored in one place and is easily accessed. Therefore, the HIS of an organization provides security, mobility, ease of access and minimize overhead costs.

The HIS should be part of the health system and the statistical system at large. Health related statistics can be used by a government to make certain decisions. Such information

can only be available when the system used is well implemented and can easily give statistical data. Data demand and supply vary in complex ways depending on the level of the health system. For effective clinical management and to assess the level at which services meet patient demand information is vital. Clinical information is not only required at the hospital level, but also in national level, especially for resource allocation (AbouZahr & Boerma, 2005; Melman, Parlikad, & Cameron, 2021).

Clinical information for a long time has been collected and entered manually. In recent times usage of HIS has been advocated to be more efficient. Carrying out research, epidemiological surveillance, and quality assurance can be effectively done by automation. Studies have indicated that this is cost savings, efficient in matching large electronically stored data sets, and reduces errors when electronic methods are used (Newgard, Zive, Jui, Weathers, & Daya, 2012). A HIS would play a major role in monitoring and managing clinical events. Real-time decisions would be made possible with timely feedback on data entered. Alerts and reminders would also be generated easily (Horsky, Gutnik, & Patel, 2006). A well-designed IS may automate tasks that are routine to only require supervision from staff. Such systems may reorder tasks according to their priority while managing their flow according to the changes.

An Electronic Health Record (EHR) is a patient's medical history that is in an electronic form and is maintained by the service care provider to improve efficiency and decisionmaking (Ben-Assuli, Shabtai, & Leshno, 2013). EHR carries patient's past health history, diagnosis, medication and treatment plans, allergies, immunization status, and laboratory test results as well as the radiology reports and images. It has enhanced electronic ordering and improved decision making on the clinical support system (King, Patel, Jamoom, & Furukawa, 2014). Therefore, EHR forms the main element of the organizations' HIS. Electronic Health Record has benefits to the patients and the organization. EHR provides a record of patient's medication and automatically detects a problem whenever a new drug is given hence alerting the clinicians of possible allergies. When emergencies occur and the patient is unconscious, medical providers adjust accordingly because information on his or her life-threatening allergy is available. Operational problems are corrected easily, and consequences that are more severe avoided hence a positive patient outcome.

Secondly, EHR enhance the availability of information among nurses, doctors, care providers, and patients themselves. The information can be accessed anytime whenever it is needed. EHR provides complete and reliable information about patient's medical history leading to better outcomes. Proper decisions are made through alerts and reminders (Car, Huang, Sloot, & Franklin, 2017). Through E-prescribing, patients and care providers with busy lives enjoy convenience in their health care commitments.

Additionally, EHRs have enhanced care coordination due to intensified quick access to patient's record. Every care provider has the same accurate information about a patient and can do a follow up (Zhang, Pakhomov, Arsoniadis, Lee, Wang, & Melton, 2017). It is most important and recommended for patients seeing multiple practitioners, those changing care settings and those receiving emergency treatments. Medical errors and double tests are in turn reduces (Narcisse, Kippenbrock, Odell, & Buron, 2013).

EHRs have led to improve quality and efficient health care (Campanella, Lovato, Marone, Fallacara, Mancuso, Ricciardi, & Specchia, 2015). As a result, doctors and nurses spend most of their time on the patient rather than writing for progress notes and prescriptions on paper. More patients are attended within the same timeframe. Therefore, the clinical alerts also remind patients of their scheduled appointments, and this reduces the chances of not being seen by the physician (Lafata, Shay, Brown, & Street, 2016). Medical providers also can provide best care even when they are not in the office because the information is available online.

Further, EHR helps healthcare organization to reduce costs and save time. Cost reduction is seen through decreased paperwork and better utilization of resources. Organizations do not need to purchase extra materials for keeping patient's health care record. Duplicate testing is also minimized because a care provider has a record of all lab tests for the patient. Besides, the time that would have been spent doing paperwork and testing can be used in doing meaningful activities that enhance good health care (Secginli, Erdogan, & Monsen, 2014).

Although EHRs have been in existence for half a century, adoption among hospitals has been slow. The slow adoption has been attributed to barriers both within the organization and among patients (McAlearney, Hefner, Sieck, & Huerta, 2015). Hospitals without EHRs use different files for each of their agencies. In turn, patient's information from one department is not accessible to other departments. The problem of data availability among different departments can be dealt with through the adoption of electronic systems. Storing data on files does not save on time because it involves faxing the patient's information to the pharmacist who enters the raw data into his computer. Health of the patient can also be at risk. EHRs help medical professionals to have quick access on patient's data, to verify, edit or insert new information. Through EHRs patients are engaged and can monitor their progress through consultations in decision making that pertain their health (Kohli, & Tan, 2016). Due to its numerous benefits, EHR adoption among doctors and other healthcare providers has increased. Despite the drawbacks faced by healthcare organizations to adopt EHRs entirely, the benefits are likely to outweigh the disadvantages (Hamid, & Cline, 2013). Its ability to enhance improved health care, reduce medical errors, and improve the quality of public health makes the system advantageous. Additionally, its ability to integrate and exchange information with each

other and even in different organizations has made nurses, doctors, medical care providers, and patient to integrate the system (Frazee, Harmon, & Papaconstantino, 2016).

2.2.2 Electronic prescription (EP) importance

E-prescribing also called electronic prescribing is the system that allows doctors, nurses, and other medical practitioners to write and send patient's prescription to the pharmacists electronically (Parv, Kruus, Mõtte, & Ross, 2016). Therefore, doctors and nurses will not do faxes, paperwork, or even call pharmacists to give a prescription.

A good number of hospitals and pharmacies have started using the E-prescribing system. Numerous benefits to the organizations and patients who use the E-prescribing system have been witnessed. To start with, E-prescribing has improved the quality and efficiency of the prescribing process as opposed to paperwork. This is because the prescription is not written manually, and little time is required to explain electronic prescriptions. Moreover, physicians have enough information at the time of prescribing, and this reduces the number of follow up calls between the doctor and the pharmacist (Tolley, 2012).

Furthermore, patient's safety is enhanced when E-prescribing is used. Medical errors are reduced because pharmacists do not have to interpret medical prescriptions (Gider, Ocak, & Top, 2015). The errors might include a doctor selecting the wrong or unavailable drug, misinterpretation of information due to bad handwriting, poor transcription, dosage, and omission of relevant information (Figge, Fox, & Tribble, 2009). E-prescribing system alerts the prescribers of such errors to be rectified in time before transmission.

E-prescribing saves on cost hence a financial benefit to both the patients and the organizations. Patients do not have to keep visiting health care centers and emergency rooms. The system can also alert prescribers of therapies that are very expensive and can

be discontinued in favor of cheap and manageable one. Moreover, the organizations can save cost of paperwork and faxes. Electronic delivery of prescriptions to the pharmacy reduces the waiting time for the patient (Robinson, Figge, Stein, & Russell, 2011).

Policymakers and insurers are also concerned with the rising cost of the medical prescription. Hospital information technology is seen as a measure that will help to reduce the cost of the prescription with Formulary Decision Support (FDS) on medication. According to Fischer *et al.* (2008), health care spends a lot of finance in prescribing medicine which has prompted policy makers and health insurance to develop a system that will enable both health care providers and patient save cost with a proper prescription.

Although there is limited use of E-prescribing with FDS, health insurance calculates that the adoption of e-prescribing with FDS could amount to a saving of US dollar 845000 per 100,000 patients. In addition, higher uses of the e-prescribing could lead to increase in the cost of saving over time. However, there is a varying financial effect of using these hospital information systems in the cost of prescription and the volume of medicine in consumption. According to Fischer *et al.* (2008), results from previous research indicate that there is a substantial cost saving on drugs on the stipulation that more medication that is generic is prescribed occasionally. Using e-prescription and FDS to aid in medication prescription has been greatly found to be cost effective over other methods of prescription.

Thomas *et al.* (2013) stated that implementation of e-prescribing program was accepted by many physicians due to the associated benefits which exceeds the risk factors. The eprescribing program implemented in several states have helped to improve doctors and physician's prescription on controlled substance. The e-prescribing program helped to maintain records of patient pharmaceutical purchases, prescription, and refill dates of the medication. It also managed an array of information such as the age of the patient prescription made to, their demography, and their last health care where the refill was made last, and the duration of their prescription. This ensured a successful implementation of the program.

Above all, E-prescribing increases medical adherence among the patients (Salah, Alkalaldeh, Al-Omari, Al-Niemat, Baninasur, & Bisharat, 2016). With mobile application alerts and refill reminders, patients can take the medicines as directed and refill them on time as well as can get necessary follow-ups with their doctors. The practice promotes a better health care. On top of this, a patient who is traveling and runs out of medicine does not have to worry anymore because his or her physician can do an emergency refill (Figge, Fox, & Tribble, 2009). The issue of adverse drug reaction is dealt with, reducing the chances of re-admissions (Adler-Milstein, Everson, & Lee, 2015).

According to the study conducted by Laplante, Rosen, and Dube (2011), 64% of physicians and medical providers agreed that e-prescribing improved their workflow and was efficient in a terms of report generation. More importantly, they agreed that the system helped to minimize error associated problems, refills were made aptly, and improved formularies, especially in polypharmacy.

E-prescribing is an essential tool for hospital information system. It helps information system in the organization and improve the structure of workflow, which optimize outcomes as well as operationalization. This information system aids in the management of hospital prescription database, which is vital in monitoring-controlled substance, diversions, doctors shopping that law requires being regulated because it is costly for the economy as well as help providers. This system provides an avenue through which a physician can easily track the patient's prescription history more efficiently than other methods such as computerized fax prescription which 24% physicians supported as efficient (Laplante, Rosen, & Dube, 2011).

Gagnon, *et al.* (2015) found that many issues can deter apt implementation of the electronic prescribing network. Many physicians think that the workflow environment should be adopted for the implementation of the system, which will aid its implementation and adaption to the environment.

E-prescribing that is integrated with electronic health record or HIS provides the opportunity to access all patient health information stored in the EHR. E-prescribing systems integrated with EHR are likely to reduce adverse effects in medication for example reactions that are allergic, incorrect dose calculation, and drug-drug reactions (Carling, Kirkehei, Dalsbø, & Paulsen, 2013). A clinician views the laboratory results, diagnosis, the clinical notes, and any list of problems and this makes them prescribe the best medication for his or her patients. Research has shown that more than fifty EHR offer E-prescribing that is integrated, Integrated EHR is highly recommended for practices that offer full automation and interoperability with other service care providers organizations. The main advantage of Integrated EHR is that they are cost effective as compared to stand alone E-prescribers (Parv, Kruus, Mõtte, & Ross, 2016).

E-prescribing has taken interoperability to a high level and advanced the working of HIE systems by acting as a tool to service care providers to trace and access patient's history electronically. EHR provides a patient's full medical history, current test results and other physicians recommendation hence the patient can be attended to by different clinicians (Esmaeilzadeh & Sambasivan, 2017). However, for E-prescription especially with respect to interoperability between systems, and organizations, technology design issues be addressed to ensure all the features are compatible (Odukoya, Stone, & Chui, 2014).

In medication, either the doctor or the patient can misplace prescription done on paperwork; the prescription may be misread leading to errors in dosage or being given the wrong medication (Harvey, Avery, Hibberd, & Barber, 2014). E-prescribing has given a chance to physicians and pharmacists to communicate to one another directly. The result reduces errors and saves time by culminating the issue of lost prescriptions. Additionally, workflow between the doctor and the pharmacy is also improved (Keller, Kelling, Cornelius, Oni, & Bright, 2015). E-prescription can be written, edited, and made proper improvements. It also can be accessed from anywhere by the legalized individuals. The chances of losing patients' information through E-prescribing system is minimal; hence, a good record keeping enhances patients' safety. It is through E-prescribing that a clinician does not have to keep checking on files to trace patient's last data and then be sure to return to the appropriate place because data is stored online. The system has been able to address all ills in the current paper-based system (Salah, Alkalaldeh, Al-Omari, Al-Niemat, Baninasur, & Bisharat, 2016).

E-prescription will facilitate the HIE with other health care organization as it plays a vital role for any health organization HIS. E-prescription system integrated with the EHR should be compatible with other different EHR to make interoperability among different EHR system. This process can help in exchanging medication history of a patient including controlled substances history which in turn helps in making the right clinical decision to reduce overdose and stop doctor shopping behavior among patients.

Various healthcare institutions in Saudi Arabia are abandoning the manual processes in favor of technology interventions due to the inability to guarantee medication safety as physician's order did not require a review by the pharmacy (Alghamdy, Randhawa, Al-Wahhas, & Al-Jumaan, 2015). The problem with the manual process is that the narcotics and controlled substances cabinet cannot be linked with the pharmacy information system. The implication is that pharmacy is not able to counter check whether the patient was given the correct medication, dosage, and expected frequency. Alsultan, Khurshid, Mayet, and Al-jedai (2012) surveyed the health care system in Saudi Arabia to determine the extent that automation has been implemented for administration and management of

inpatient pharmacies. According to the findings of the study that involved 29 hospitals, centralized distribution (74%) was the most common approach for inpatient pharmacies. It was noted that 21% of the hospitals used bar coding technology when dispensing medication. No hospital had automated dispensing of unit doses through the robotic distribution.

According to Alkraiji, Jackson, and Murray (2013), tertiary hospitals in Saudi Arabia are mainly concerned with the creation of networks, platforms, and related advanced clinical system but not health data standards. The result is that healthcare providers are forced to operate with multiple formats of information infrastructure that are hard to integrate and manage. Technology related to storage, dispensing of opioids will depend on policy, and procedures set by the health care provider in addition to the qualification and experience of the staff. Examples of healthcare providers who have adopted new technology related to controlled substances include the Prince Sultan Military Medical City (PSMMC), established and managed by the Medical Services Department of the Ministry of Defense and King Abdullah Medical City (KAMC) (BD, 2015; Binobaid, Fan, & Almeziny, 2016). Both facilities implemented the PyxisTM technologies for tracking the movement of narcotics and controlled substances within the institutions. The technologies include Pyxis Med Station[™] system used in advanced automated dispensing cabinets (ADCs). Additionally, it comes with Pyxis CIISafeTM system useful in improvement of storage, tracking, and documentation of controlled drugs. The technology ensures every Med Stations is linked to the Pharmacy Information System to ensure effective description of roles and permissions based on user accounts that ensure access and removal of narcotics and controlled substances are limited to authorized persons only. Bar code scanning of unit-dose opioid medication promotes accuracy in restocking.

2.2.3 Integration in HIS

Integration in HIS not only consolidates several computing systems, but it also integrates software applications for the intent of greater functionality. Shahmoradi & Habibi-Koolaee (2016) explained that the integration of HIS's incorporates the usage of techniques such as grid computing, service-oriented architecture (SOA), workflow management, enterprise application integration (EAI) among others. In brief, it comprises of five vital entities: data generation, gathering, analysis, synthesis, transmission, and utilization. The primary intent is to simply provide better healthcare quality as this is the sole reason medical facilities are in existence in the first place otherwise, we would have regarding Integration in HIS. Some are proponents of this program while others happen to be great antagonists of the same.

Certain study was conducted in Kentucky, and it conveyed that approximately 7 out of 10 Kentuckians preferred that both physical and mental healthcare amenities should be conducted within the same locality (Foundation for a healthy Kentucky, 2012). This means that they are advocates of the notion although the same statistics reveal that the number of proponents has been declining over the years. The reason for that is unknown. World Health Organization (2017) also tops up on the list of proponents as they target to make the world a haven by creating a universal healthcare system. Additionally, they have come up with a variety of programs that advocate for interoperability in administering healthcare amenities.

Jayanthi's article (2015) features several topnotch healthcare experts that give their sentiments about integrated healthcare systems. In reference to the article, Dan Haley suggests that it is more of a bidirectional interface. Michael Johns asserts that both clinicians and patients benefit from the interoperability as well as integration of the

systems. Patients of course get the best of healthcare while clinicians have fewer workloads since the system is integrated. Joy Grosser on the other hand says that it is a system that would undeniably support predictive modeling for the entire populace as well as facilitating information exchange from one provider to another.

Coming up with integrated healthcare systems is vital. For one, when different computer systems integrate, medical care is enhanced. Patients will appreciate better services offered as it is often coordinated, and they can also navigate through the various sectors of the health system. Secondly, Laplante's article (2005) quoted those costs incurred out of fragmented and improper healthcare are often managed upon system integration. When doctors tend to act independently, prices often escalate as there is no evident tracking system available and they can therefore impose high rates. Thirdly, there is the assertion of disease self-management. What does this mean? The integration offers half a chance for patients to monitor and take charge of their health progress. Therefore, the patient does not miss any relevant information concerning his or her well-being. Further on the list, diagnosis of patients' conditions is made earlier consequently curbing medical errors that come along upon relying on individual doctors. Doctors are also human, and human is to error, so they are no exceptions. Two heads are better than one so when one messes up, the other one salvages the ship from sinking by sharing information (Laplante, 2005). On another note, the system gains leverage over the available amenities offered across the facilities thus healthcare systems in rural areas are not placed at a disadvantage but are rather rendered sufficient healthcare providers. Moreover, there happens to be a constant flow of data and information across the hospitals and the various communities at large. This undeniably adds value and nearly all institutions become at par with the upto-date affairs affecting the medical field (Li, Ge, Zhou, & Valerdi, 2012). Nonetheless, integration of healthcare systems brings about enhancements regarding creating a better working environment to the state government agencies or better still, the commonwealth

financed programs with the aim of achieving better results and making positive impacts in the society. Furthermore, the integrated systems offer a wider avenue of out-of-hospital community-based care services (Buntin, Burke, Hoaglin, & Blumenthal, 2011). Patients can access healthcare amenities within their localities thus decreasing regular hospitalizations, constant hospital admissions as well as frequency in Emergency Department attendance. This in turn presents a wider platform to advance the quality of healthcare and gain it in the right places. Incentives are also straightened out in a better manner upon integration of healthcare systems. Additionally, there is the advantage of quality integrated delivery. This therefore creates a systemized platform. There is also a benefit of proper healthcare decision-making. The choices that are made cover a wide scope of the field without neglecting any locality since the systems are integrated.

There is increased focus on the value of the internet in preventing misuse of opioids (Bert, Galis, Passi, Rosaria Gualano, & Siliquini, 2015). The effort is based on the recognition that doctor shopping is one of the main causes of increased opioid misuse. According to Buykx Loxley, Dietze, & Ritter (2010), doctors shopping is part of the problem since 19% of the study's participants overdosed with drugs acquired through the practice. Nielsen and Barratt (2009) noted an example of how the internet has been used to curb misuse using a system that provides a real-time prescription, monitoring was implemented in British Columbia, a province in Canada. The program allows online access to the patient's prescription history from the past 14 months, which means the dispensing pharmacist can detect possible misuse of the drugs. Such programs have been implemented in other regions of the world including Australia where the authority seeks to have an electronic patient record system that links prescribers, hospitals, pharmacists, and insurers with an access to patient medication information.

Based on the existing information about the application of technology in the prevention of opioid misuse, the issue is complicated due to the need to strike a balance between protecting patients from addictive tendencies and avoiding a situation where they are forced to look for illicit drugs. Additionally, the healthcare providers must consider the confidentiality, privacy, and proper treatment of the real medical condition. Through interoperability and integration across systems involved in distribution, storage, prescribing, and dispensing of opioids, Saudi Arabia can achieve the balance by supporting drug acquisition in addition to monitoring and preventing misuse of opioids.

CGI group (2013) had specified Health Information Integration Framework (HIIF) model to enable health organizations to assess their readiness and capabilities for successful HIS's integration. HIIF bring both technical and business planning and execution together to ensure systems alignment for a successful systems integration. HIIF provides organizations with the approaches to conduct the change. These approaches consist of assessment, gap analysis, solution development, implementation, and steady state to ensure performance, and behavior of integration cycle.



Figure 2.1: Fundamental Assessment Types of a Successful Integration Process

Above figure illustrates the four fundamental types of assessment that forms a building blocks for a successful implementation of HIS's integration. Without performing all assessment types prior to any integration process, it will lack a vital base line for success.

According to CGI group (2013). Some of the benefits of HIS's integration in a health care setting with respect to patient care and safety include:

- Reducing medication errors especially with implementing computerized provider order entries (CPOEs) and decision support tools
- Reduction in cost associated adverse event, documentation of clinical care, test results, storage of paper information, and processing them
- Accurate and complete clinical documentation
- Communication among health care provider is improved
- Improvements in the overall patient outcomes
- Improved error reporting methodology

It is clear that integration in healthcare system makes the entire industry a small village and very manageable. It is effortless and productive to handle consolidated resources that bring about an integrated system. All these efforts are made with the only goal of improving patient experience as well as safety and expanding the industry both vertically and horizontally.

2.3 Controlled Substance / Narcotic Abuse, Misuse Epidemic History

According to FDA (Food and Drug Administration), "the key difference between drug abuse and drug misuse is the individual intentions when taking the drug". Prescription drug are mainly used to relieve individual pains and other symptoms according to the chief complained presented with, but on the other hand, it can cause harm when abused or misused. When someone abuse or misuse a prescription drug even for the first time, they will enjoy being high and euphoric ending with addiction to the same drug. To make it clearer and more specific, the following paragraph differentiate between the abuse and misuse terms. According to Free (2014), misuse of a drug occurs when a person uses a drug for a purpose other than what it was prescribed and intended for. Example of this case can be like someone who is taking a headache pain killer to stop nausea, thinking it will stop it. Misuse also includes not following the doctor instruction of use even if the person is not intending or looking to be high. Example can be seen in a person who is not going to bed after taking one sleeping pill, the person may take extra one thinking it will work. Misuse can be distinguished by multiple signs. These include taking the drug at the wrong time, forgetting to take the instructed dose, stopping the medication earlier, accepting and taking prescription medication from friends and taking the prescription drug for reasons other than what it was prescribed for (Free, 2014).

The abuse of drugs in the opiate and benzodiazepine families frequently leads to unavoidable side effects, including dependency and addiction. For example, someone taking Vicodin frequently with no prescription, no symptoms and believing they 'need' it to feel better is an example of drug abuse (Free, 2014). The use of controlled substances to reduce pain in palliative and end of life care has been accepted all over the world (Caraceni, et al., 2012; Dowell, Haegerich, & Chou, 2016). Patients suffering from different chronic diseases including various forms of cancer and those involved in accidents have benefited from reduced pain due to the adoption of opioids in the management of their conditions. Given that some of the chronic diseases may not be cured, the patients face a lifetime of pain if such prescriptions are not provided (Abdulla et al., 2013; Manglik et al., 2016). However, since the controlled substances are classified under narcotic, they have adverse effects that are associated with some of the most widely abused drugs that are available in underground markets (Bassiony, 2013; Bogusz, 2017). Consequently, the regulation of opioids has become an important goal of health care agencies in all parts of the world including Saudi Arabia. While the drugs can reduce patient's experience of pain, their distribution in the market must be restricted to avoid abuse (Wallwork, Chipidza, & Stern, 2016). Physical dependence on opioids means the patients experience severe withdrawal symptoms in addition to being at risk of overdose-related deaths (Brady, *et al.*, 2014; Leece *et al.*, 2015).

The problem with management of opioid and controlled substance use is that the drugs are sometimes widely available as prescription pain medication while the public is also poorly informed about issues such as safety and addictive nature (Alshammary, Abdullah, Duraisamy, & Anbar, 2014; Al-Zahrani, Eldali, & Al-Shahri, 2014; Isa, & El-Sabbagh, 2014). The result of this trend is an upsurge in the nonmedical use of controlled substances with the health facilities having to deal with increased patient admissions due to the adverse effects of misusing prescription opioids (Gaferi, *et al.*, 2013). Consequently, the use of opioids possesses a challenge to physicians when diagnosing and treating pain syndromes due to the difficulty in identifying individuals with high risk of the addictive disorder.

Opioid and other controlled substances use disorders are a public health problem because of the negative effect they have on patients' health and wellbeing. Prescription opioids have been increasingly used to treat chronic pain not caused by cancer in the past two and half decades. Consequently, opioids misuse and deaths caused by overdose have increased in individuals with opioid addiction and reached epidemic levels (Tetrault & Butner, 2015). Svhrager *et al.* (2014) study results indicated prescription opioids are the most regularly misused type of prescription medicine among persons aged between 18 and 25. Patients increase the dose to attain the desired effect, and this causes respiratory failure and deaths. Opioid use disorder causes a burden including 11 million life-years that are lost from health issues, disabilities, and premature death (Schuckit, 2016).

The Office of National Drug Control Policy (ONDCP, 2017) in the white house works to control and reduce the impact of the drug abuse or misuse and their consequences. The

ONDCP acknowledged the increase of death rates in the United States resulting from overdose of opioids and other controlled substances, (Figure 2.2) to the extend it made the American administration had increased the budget to fight the epidemic to 27.8 billion for the year 2018. This amount of money is to initiate a prevention measure, policies as well as treatments programs to fight and reduce the numbers of death and increase awareness and prevention, (ONDCP, 2017).



Figure 2.2: Opioids/controlled substance deaths in USA 1999-2007 Source: center for disease control and prevention, unintentional drug poising in the United States (July 2010).

In the past decade, there has been a significant rise in prescription drug overdose, misuse, death, and increased treatment. Prescription drug misuse has become a major health problem due to which the Office of National Drug Control Policy (ONDCP) aimed to reduce the overall drug abuse/misuse by 15% in the USA.



Figure 2.3: Opioids /controlled substance deaths in USA 1970-2007 Source: center for disease control and prevention, unintentional drug poising in the United States (July 2010).





Figure 2.4: Opioids /controlled substance induced deaths in USA 1999-2007 Source: center for disease control and prevention, unintentional drug poising in the United States (July 2010).

All the above three graphs illustrate much of the epidemic and present the current and recent history of the issue that requires immediate actions by governments to eliminate its impacts and reduce overdose and abuse increasing death rates.

In the past decade, prescription opioid abuse, addiction, or misuse has become a global health issue, specifically affecting developed nations such as the US, UK, European Union, India, China, and Gulf Countries. Based on current evidence, there has been an exponential increase in the non-medical use of prescription pain killers. In a recent report, an estimated 12.5 million people use pain killers for non-medical purposes in 2007 compared to 11 million people in 2002 in the US. An estimated \$55 billion was spent on issues related to opioid drug abuse, addiction, and misuse (Meyer *et al.*, 2014).

Opioid abuse or overdose is associated with increased risk of death, specifically among young adults and elderly patients. An estimated of 14,800 people had died in 2008 while 5,528 people had died in 2002 due to opioid overdose. Based on recent reports, an estimated of 830,652 years of life before the age of 65 has been lost due to opioid and other controlled substances overdose related deaths (Meyer *et al.*, 2014). Figures below display the increase in death rates in USA resulting from drugs abuse/misuse.







Figure 2.6: Total number of US overdose deaths involving opioid drugs from 2002 to 2015. Included in this number are opioid analgesics, along with heroin and illicit synthetic opioids.





Figure 2.7: The total number of US overdose deaths involving opioid pain relievers (excluding non-methadone synthetics) from 2002 to 2015. Non-methadone synthetics is a category dominated by illicit fentanyl and has been excluded to reflect deaths more accurately from prescription opioids. Source: National Center for Health Statistics, CDC Wonder



Figure 2.8: Number of Deaths from Benzodiazepines, with and without opioids, from 2002 to 2015. Source: National Center for Health Statistics, CDC Wonder

Atluri *et al.* (2014) extend the research conducted on trends in opioid misuse in the emergency department. The authors' primary objective was to determine the portion of drug abuse associated with opioid analgesics. The study also investigated the various trends in 8 major opioids that are abused across the US. It was established that since 2004 to 2011, there was an increase in medical use for the eight major opioids. The abuse of the opioid also increased during the period that was observed. A key observed aspect was the increase in the use of buprenorphine that increased by 2,318% while codeine recorded the lowest levels that decreased by 20%. According to the study, there was an increase as well as misuse of opioids across the US in the period of the research (Atluri *et al.*, 2014).

According to Fischer and Jürgen (2015), prescription opioids have risen in Canada's major cities such as Ontario and Alberta. The reason behind this misuse of opioids is traced to higher dispensation levels of strong prescription opioids. The author sheds light on the rise of non-medical prescription opioids in Ontario's adult population from 2.8% to 7.7% from 2008 to 2010. Fischer & Jürgen's works offer compelling evidence through categorization of the dispensation of prescription opioids into weak and strong form to

represent the 5,700 retail pharmacies across Canada. The US and Canada are among the countries leading in higher levels of Defined Daily Doses (DDD) of prescription opioid analgesics (POA) in the world. The research established that higher levels of Prescription opioids in Canada have been associated with morbidity and mortality. Besides, availability of prescription opioids has led to a quadruple in overdose related deaths since 2002 (Fischer & Jürgen, 2015).

A study by Dart *et al.* (2015) on trends in opioids abuse in the US, revealed that the number of opioid-related deaths reached 16,651 in the year 2010. The authors also established that the federal, regional, and state bodies implemented interventions to tackle the abuse of opioids. A key remark established by the researchers was that the death rate linked to heroin use was inversely related to death rate associated with abuse of prescription opioids (Dart *et al.*, 2015).

A national survey led by Ives (2006) found that opioid misuse had increased over the decade. In the research, Utah and North Carolina registered an increase in unintentional deaths because of an overdose in non-medical opioids abuse. Besides, the research established an increase in opioid use amongst trauma patients. The researchers conducted a study on cohorts for a period of one year to determine predictors of opioid misuse amongst patients registered in chronic pain management. The study identified that mood, literacy, social-demographic data, disability, and assessment of pain as key predictors for opioid misuse by patients (Ives *et al.*, 2006, p. 57).

June *et al.* (2016) investigated the relationship between medical marijuana laws and the possibility or chance of a positive opioid test. The study carried out by Columbia university established that there were fewer number of drivers killed in car crash who had previously tested positive for opioids in states that had transitioned to medical marijuana laws as opposed to those that did not. June and fellow researchers are among the first to

establish a link between medical marijuana laws and the use of opioids at individual levels.

The research analyzed data between 1999 and 2013 across 18 states on the Fatality Analysis Reporting System (FARS). The survey further concentrated on states that conducted a test for alcohol and other drugs for crash fatality drivers within an hour after the accident. The study was also keen to note within-state and between state positive opioid tests on drivers that crashed in regions that had medical marijuana law operating (June *et al.*, 2016).

Researchers at John Hopkins Bloomberg School of Public Health led by Kennedy-Hendricks (2011), established that over 1,029 individuals in the state of Florida died because of prescription opioids overdose in a 34-months period. The state of Florida enacted various laws in 2010 and 2011 that governed dispensation of opioids in pain clinics. The authors also found out that the fewer deaths in Florida because of prescription laws of opioids were also linked to lower heroin use in 2011 and 2012. This clearly diverges from the various research that controlling or reducing prescription of opioids will eventually lead to an increase in the use of heroin (Kennedy-Hendricks *et al.*, 2011).

Atluri *et al.* (2014) extend the research conducted on trends in opioid misuse in the emergency department. The authors' primary objective was to determine the portion of drug abuse associated with opioid analgesics. The study also investigated the various trends in 8 major opioids that are abused across the US. It was established that since 2004 to 2011, there was an increase in medical use for the eight major opioids. The abuse of the opioid also increased during the period that was observed. A key observed aspect was the increase in the use of buprenorphine that increased by 2,318% while codeine recorded the lowest levels that decreased by 20%. According to the study, there was increase misuse of opioids across the US in the period of the research (Atluri *et al.*, 2014).

Studies conducted by Heneka *et al.* (2006) sought to identify incidences, types as well as the effects of opioid medication errors amongst adults in palliative care and oncology. Other objectives of the researchers in the study were to explore the attitude of clinicians towards opioid errors. Scholars emphasized that opioid overdose or abuse on palliative patients poses more risk to the individual as the complexity of the illness, co-morbidities, and age makes it easy for a clinician to cause an accidental or negligent death. The research underpins the extent to which opioid errors in palliative care are under-reported. It also recognizes human factors and skill gap and knowledge to be key motivators of opioid errors in palliative care (Heneka *et al.*, 2006)

Prescription drug abuse/misuse is a global healthcare problem, wherein the overall incidence rate is associated with high social and healthcare costs (Worley, 2012). In the US, prescription opioid abuse or overdose is a major epidemic or public health issues affecting thousands of people every year. The fatality rate of opioid abuse has tripled from 1.4 deaths for every 100,000 individuals in 1999 to 5.4 deaths for every individual in 2011 (Haffajee *et al.* 2015). An estimated 36,000 deaths were reported in 2008 due to fatal drug overdose in the US which reflects the seriousness of controlled substance abuse (Gabay, 2015).

The financial cost resulting from abuse and misuse of controlled substances in US is more than \$740 billion annually. This cost covers crimes related to controlled drugs, poor work productivity, and health care services rendered to victims including expenditure on drugs (NIDA, 2017). The overall cost of illicit drugs includes the misuse and abuse of prescription drugs. On a separate analysis report of 2007 data estimated US cost of prescription opioids misuse at \$55.7 billion. In 2013, a recent report based on 2013 data updated this cost to \$78.5 billion, an increase of more than \$20 billion per year compared to six years ago (NIDA, 2017).

The overall cost of illicit drugs includes the misuse of prescription drugs, however the exact estimate for this category is not stated in the 2011 report. A separate analysis of 2007 data estimated US costs of prescription opioid misuse at \$55.7 billion. The most recent estimate of prescription opioid misuse, based on 2013 data, updated this cost to \$78.5 billion, an increase of more than \$20 billion per year compared to six years ago. Taken together, with the growing misuse of opioids and related health consequences, the cost estimates for illicit drug use in the US are likely to have risen substantially since the last available estimate in 2007.

	Health Care	Overall	Year Estimate Based On
Tobacco	\$168 billion	\$300 billion	2010
Alcohol	\$27 billion	\$249 billion	2010
Illicit Drugs	\$11 billion	\$193 billion	2007
Prescription Opioids	\$26 billion	\$78.5 billion	2013

Figure 2.9: Cost of Substances Abuse in US (NIDA, 2017)

According to Curtis (2016), it is important to assess and evaluate the economic burden of prescripton drug abuse, misuse, overdosne, and dependence. Such an estimate would help decision maker, clinical team, and researchers to know the magnitude of the issue in order to plan and choose the cost efficitve options to manage this epidemic as well as evaluating other preventive meassures to reduce this risky behaviour.

In this report, scholars claims that it is extremely difficult to measure all costs involved in this epidemic since some aspect are not meassurable nor available such as the reduction in life quality and the amount of pain families of the victime went through (Curtis *et al*, 2016).



Figure 2.10: Distribution of the economic burden of prescription opioid overdose, abuse and dependence (Florence, 2016)

Financial cost of prescription opioids is high because of the high rates of physician visits, mental health inpatient, and outpatient services and admissions. Also, the high cost is associated with increased rates of emergency department visits, motor accidents, trauma, and substance abuse treatment. Studies have shown the cost for persons abusing opioid is 8 times more than the cost for non-abusers (\$15,884 vs. \$1830) (Hahn, 2011). However, opioid misuse or addiction has been associated with increased utilization of emergency medical care services, increased inpatient hospital stays, increased physician outpatient visits, and increased healthcare expenditure. People with substance abuse issues, specifically opioid abuse or misuse have a higher rate of healthcare expenditure compared to non-opioid abusers. In a recent report, an estimated \$14,054 to \$20,546 in excess was spent by an opioid abuser compared to a non-opioid abuser (Meyer *et al.*, 2014).

Another cost-effective factor was studied by Stewart *et al.* (2014) who had evaluated quantities and types of medications in unused medication return program as well as the promotion of medication waste. Data collected in 11 cities from 2011-2013 during 6 drugs enforcement administration by well-trained pharmacy student volunteers was analyzed for medication classification, controlled substance categorization, therapeutic class, and percentage of waste, the study showed that Medication take-back events resulted in return

of 13,599 individual medications from 1,049 participants indicating a significant quantities of medication return, this includes controlled substances. The author concluded the study by emphasizing the need for a medication collection program to further investigate and improve the communities' health as result of high quantities of return and waste. At the end, they identified areas of further research such as demographics of those returning unused medications. Also, more efforts on how to reduce medication costs based on the return quantities need to be done in the future (Stewart *et al.*, 2014).

In the past decade, there has been a significant increase in prescription opioid abuse. To prevent and control such a public health issue, pharmacist have recommended the development and implementation of a prescription drug monitoring program (PDMP) across the states. The deployment of a universal PDMP program can help combat controlled substance misuse. A well-developed and structured PMPD can help various stakeholders such as physicians, pharmacists, and even patients benefit from prescription opioid abuse or misuse. The use of a government enforced PMP can help combat opioid misuse in several countries. However, awareness and knowledge of such PDMPs is a critical factor in its wide-spread acceptance and utilization (Fleming *et al.*, 2013).

The need to develop and implement a national prescription drug reporting program is a critical component to reduce the burden of controlled substance abuse related morbidity and mortality. In the US, the development of a national prescription drug reporting program received positive claim from policy makers, public health leaders, the physician community, and the pharmacist association. The rate of opioid-related abuse and addiction would be reduced with the implementation of the national prescription drug reporting reporting program (Shepherd, 2014).

Prescription drug abuse is a critical component of the healthcare system which often reflects poor or unorganized systems. In most cases, opioid abuse has a negative impact on the overall clinical and economic condition of the patient. Opioid abuse adversely impacts commercial and government sectors, health care providers, patients, and the society. Prescription opioid abuse is also associated with increased risk for multiple addictions, including hallucinogens, cocaine, or heroin (Meyer *et al.*, 2014). Thus, opioid abuse has a profound negative impact on the healthcare system and society.

2.3.1 Controlled substances abuse in Saudi Arabia

Substance abuse is a public health issue in many countries, including Saudi Arabia and it is associated with mental conditions, psychiatric disorders, and social and occupational consequences (Bassiony, 2013; McHugh, Nielsen, & Weiss, 2015). Patients suffering from different chronic diseases including various forms of cancer and those involved in accidents have benefited from reduced pain due to the adoption of opioids in the management of their pain. Given that some of the chronic diseases may not be cured, the patients face a lifetime pain if such prescriptions are not provided (Abdulla *et al.*, 2013; Manglik *et al.*, 2016). Consequently, the regulation of opioids has become an important goal of health care agencies in all parts of the world including Saudi Arabia. While the drugs can reduce patient's experience of pain, their distribution in the market must be restricted to avoid abuse (Wallwork, Chipidza, & Stern, 2016). Physical dependence on opioids means the patients experience severe withdrawal symptoms in addition to being at risk of overdose-related deaths (Brady, *et al.*, 2014; Leece *et al.*, 2015). In Saudi Arabia, the impact of opioid use/misuse is substantial due to lack of a structured healthcare program or database to access or monitor prescription drug misuse or abuse.

The fatality rate of opioid abuse in Saudi Arabia has increased exponentially. A total of 249 deaths were reported due to prescription drug abuse between 1990 and 1997. However, the fatality rate was high among men compared to women while substance abuse complications were common among adolescent or young men. Based on the report,

prescribed medication, opiates, alcohol, and carbon monoxide were common overdose fatalities observed in Saudi Arabia. However, opiates constituted for 47% of deaths followed by medically prescribed drugs (20%), alcohol (11%), and carbon monoxide (10.5%). However, researchers indicated that there was a sharp fall in overall substance abuse-related deaths in Saudi Arabia in the past 5 years but complications due to overdose remained high (Elfawal, 1999). Al-Zahrani (2009) reported an increase in the addicted figures in Saudi Arabia by 300% within the last two years particularly in the eastern province among male, while the percentage is less among females in the same region.

Chemical poisoning and drug overdose are one of the most common health issues in Saudi Arabia, specifically affecting women and children. In a recent report, a team of experts indicated that 54% of females were negatively impacted due to drug overdose followed by children (below 12 years) comprising of 44% of the total chemical poisoning cases. However, drug overdose constituted of 92% of chemical poisoning cases, wherein the use of analgesics and non-steroidal anti-inflammatory drugs (NSAIDs) were the most common drugs. In most cases of chemical poisoning due to drug overdose, 41% comprised of gastrointestinal symptoms while 57% comprised of central nervous symptoms. Suicide was considered as the most common cause for drug abuse, specifically among females. However, easy access to medications at home was associated with increased risk of chemical poisoning in children. Thus, women and children are the most affected due to drug overdose in Saudi Arabia (Bakhaidar *et al.*, 2015).

The problem with management of opioid use is that the drugs are sometimes widely available as prescription pain medication while the public is also poorly informed about issues such as safety and addictive nature (Alshammary, Abdullah, Duraisamy, & Anbar, 2014; Al-Zahrani, Eldali, & Al-Shahri, 2014; Isa & El-Sabbagh, 2014). The result of this trend is an upsurge in the nonmedical use of controlled substances with the health facilities having to deal with increased patient admissions due to the adverse effects of misusing prescription opioids (Gaferi, *et al.*, 2013). Consequently, the use of opioids possesses a challenge to physicians when diagnosing and treating pain syndromes due to the difficulty in identifying individuals with high risk of the addictive disorder.

The UNODC (2011) reported that about 8% of opioid treatment demand is by people who abuse the pain medications. The prevalence of opioids by 2006 was 0.06 per 100,000 people in the kingdom. Doctor shopping has also emerged as a concern with higher quartile income associated with greater risk of death (33.1%) due to opioid analgesics (Al-Jaser, Epi, & Awofeso, 2013).

In Saudi Arabia, the ministry of health is responsible for providing guidelines to govern the control of distribution, prescription, dispensing, storing, and disposing of controlled substances and narcotics (Eid, Manias, Bucknall, & Almazrooa, 2014). To achieve this, Saudi Arabia's ministry of health has defined the responsibilities of various hospital personnel who handle the drugs across different stages of distribution. In addition to that, national center for health information in Saudi Arabia had set a group of policies to regulate the HIE among different health care organizations to control such an epidemic once the unified electronic medical record is live. These guidelines will be discussed in separate section. Among those with the various responsibilities in regulating opioid distribution, include the pharmacy department, which receive, store, and dispense the drugs. The pharmacist in-charge inspects, supplies, and check the expiration date of the drugs sent to each ward based on floor stock. The head nurse stores the drugs in each ward while the nurse in-charge does an audit of opioids in every shift in all nursing units. Lastly, the ministry of health describes the role of the most responsible physician as witnessing the disposal of unused drugs and fills in, signs, and stamps the opioid prescription forms (Ministry of Health, n.d).

Over the past years, the management and control of opioid distribution, prescription, dispensing, storing, and disposing has been done manually, which has been determined increase error in addition to being time-consuming (Mankes & Silver, 2013; Aljadhey, *et al.*, 2013; Qureshi, *et al.*, 2015). The process involves nurses counting and manually recording the controlled substances cabinet drug inventory in books provided by the institution. The practice is conducted at the end of every shift with a second nurse present to witness the inventory and co-sign the necessary documents. Removal of opioids from the cabin*et al*so follows a similar procedure where the nurse must review the physician's order and proceeds to record all the drug removal manually and updates the inventory in the relevant books. A second nurse must also be present. Counting of the remaining inventory, resolving any discrepancies, and request for cabinet refill must be done before the nurse in-charge ends the shift.

Current evidence indicate that substance abuse has become a common but serious health issue in Saudi. Heroin, cannabis, amphetamine, and alcohol are common agents for abuse among youth and adults in Saudi Arabia. However, amphetamine addiction and abuse accounts for 4% to 70% of substance abuse cases followed by heroin (6% to 83%), alcohol (9% to 70%), and cannabis (1% to 60%). The risk of amphetamine and cannabis fatality has increased 5-fold compared to heroin or other volatile substance abuses. In Saudi, the risk of substance abuse is associated with psychological stress and peer pressure. Hepatitis, depression, and anxiety were common comorbid conditions found among substance abuse victims or patients. Some of the common risk factors for substance abuse in Saudi Arabia include level of education, occupation, medical diseases, psychiatric disorders, legal issues, and allied socioeconomic conditions (Bassiony, 2013).

Based on current evidence, the youth in Saudi Arabia are the most vulnerable to opioid abuse, misuse, or addiction. Peer pressure and low self-control on drug samples, alcohol, and tobacco are considered key risk factors for illicit drug abuse among youth. The risk of multiple addictions is the highest among youth due to poor educational and recreational facilities. Youth in Saudi Arabia have explored at least alcohol, tobacco, or drugs which increases their vulnerability to addiction, abuse, or misuse (Beaver *et al.*, 2016). In a recent retrospective study, a team of researchers have indicated a high risk of illicit drug dependence among youth in Saudi Arabia. In the review, most youth had developed drug dependence due to prescription drug use from opiates, pain killers, and analgesics. Dependence on drugs such as opiates, cannabis, amphetamines, and cocaine. The risk of developing psychotic symptoms such as depression, suicide, and anxiety is common among youth (Alibrahim *et al.*, 2012). Lastly, a team of researchers have also reported that youth are at high risk of developing psychotic symptoms due to drug dependence. However, chronic prescription drug use, peer pressure, and lack of self-control are key risk factors for drug dependence among youth in Saudi Arabia (Al-Jahdali *et al.*, 2004).

Figures 2.11 & 2.12 indicate minor increase in the number of drug addiction/drug abuse patients presenting to AL-Amal hospital in Riyadh city as well as psychiatric patients for the period of 1434-1437 Hijra calendar as reported by statistics department. Most of the increases comes to the outpatient clinics area. The consistency of numbers over the displayed period regardless of the insignificant increase shows a poor management of the abuse/misuse issues in the kingdom of Saudi Arabia.



Figure 2.11: Number of drug addiction/abuse cases presenting to the Alamal hospital for the period 1434H-1437H. Statistics dept. (Alamal hospital, 2017)



Figure 2.12: The number of psychiatric patients treated in Alamal hospital in Riyadh City for the period 1434H-1438 H. Statistics dept. (Alamal hospital, 2018)

Opioid abuse among other substance abuse cases is associated with increased hospital admission. In the past two decades, the healthcare system of Saudi Arabia has highly evolved with the emergence of new medications and treatment interventions. However, the increase in availability of new medications has been associated with increased risk of
potential abuse, misuse, and diversion. Young adults, adolescents, and even elderly patients have been reported to be addicted to opiates or other illicit drugs. The increase in prescription drugs for pain, psychotic disorders, and complex medical conditions has increased the risk of abuse and abuse-related hospital admissions. Adverse drug reactions from prescribed drugs within a hospital care setting has been attributed with increased healthcare expenditure, hospital stay, and poor health outcomes. In a recent report from WHO (2018), death rate from drug use in Saudi Arabia increased to 1.24 per 100.000.

In Saudi Arabia, drug addiction/abuse specifically opioid misuse has increased exponentially due to lack of effective strategies or interventions on a local or national level. Although prescription drug abuse is on a rise in Saudi Arabia, there is lack of a national-level drug monitoring system or program to track down misuse rates. There is an active adverse drug reporting (ADR) system in Saudi Arabia. However, the overall awareness, utilization, and acceptability of such systems is poor. Based on current evidence, pharmacists are placed in poor working conditions wherein professional ethics and processes are barely assessed or reviewed. Pharmacists often lack any support from private or public agencies even to document or report drug abuse or adverse event cases. Most pharmacists lack basic knowledge and awareness on reporting processes and systems (Khan, 2013). There is lack of a systematic or organized pharmacovigilance system in Saudi Arabia which magnifies the issue of drug abuse, addiction, and misuse (Aljadhey *et al.*, 2015).

Doctor shopping can be defined as seeking multiple treatment providers for a single or specific disease/illness or with the sole intention to procure medications illicitly. However, there are several factors that contribute to doctor shopping such as patient's convenience, location or office hours of the physician, person traits or characteristics of the physician/provider, patient-clinician communication, or allied psychological factors. Doctor shopping can also be defined as the phenomenon when a patient visits 3 or more

primary care sites during the same illness period to assess or anticipate best health outcomes. Again, in this case doctor shopping is not associated with the intention of procuring prescription drugs illicitly. Another form of doctor shopping is where patients seek consultation with multiple doctors at the same time or visits specialists without any referrals during the same illness period. Again, in this case, the intention is to seek right information from multiple providers and access or visit only a single provider based on psychological belief. The scope of procuring prescription drugs unlawfully is limited in such cases (Sansone & Sansone, 2012).

2.3.2 Fighting opioid/controlled substances abuse trends

Katzman *et al.* (2014) investigated the regulatory and educational approach to public health crises of chronic pain and addiction. The research is built on the premise that a lack of awareness/training and regulatory framework have led to drug misuse and overdose by clinicians. As a result, opioid addiction and abuse are tied to overprescribing of these drugs to medical treatment of pain as well as non-medical use. The paper focused on pain faculty as well as government agencies and studies over 1,000 clinicians across New Mexico. The researchers also administered a 10-item multiple-choice questionnaire to the clinicians concerning pain and opioid knowledge. They further collected surveys from six courses to compare clinicians (participants) knowledge concerning perceived competence in pain management and the caring for patients with pain & addiction (Katzman *et al.*, 2014).

The study established that state and federal legislators controlled the misuse and abuse of drugs through the enactment of new statutes and regulations that govern prescription practices. However, the rules interfered with physician-patient relationship undermining their ability to control opioid doses as per patient's needs. For the state laws to be effective, additional training and consultation by the clinicians were key components of

a successful control of abuse and misuse. The University of New Mexico Health Science Center (UNMHSC) in partnership with New Mexico Medical Board developed continuing medical education (CME) program for physicians prescribing opioid analgesics. CME programs include basic awareness of chronic pain as an epidemic, risk management, safer opioid prescription, current state, and federal regulations (Katzman *et al.*, 2014). The author structured the objectives of the paper into two that is, long-term and short-term objectives. This allows the reader to recognize immediate benefits such as knowledge, self-efficacy, and improved attitude of the clinicians. Besides, a short-term and long-term benefit that is control of drug abuse through education and regulation can be connected (Katzman *et al.*, 2014).

Starrels *et al.* (2010) sought to investigate whether experts' recommendations to carry out urine test and treatment agreements for chronic pain patients was effective in reducing opioid misuse. The study aimed to establish a connection between treatment agreements to chronic pain patients/urine test and the outcomes of opioid misuse. The researchers were able to discover a weak evidence that treatment agreements and urine tests were effective in reduction of misuse of opioids in non-cancer patients (Starrels *et al.*, 2010).

King *et al.* (2014), provide possible causes of opioid overdose in the US as well as Canada. The authors assert that opioid overdose is a combination of various biological, social, and situational factors that face individuals in the society. Their review of 47 pieces of literature concerning drug overdose identified several factors that promote or are associated with increased opioid mortality. Their research grouped these factors into three, they include prescriber behavior, user behavior/characteristics, and situational/environmental determinants.

The research established a total of 17 determinants that are linked to opioid-related deaths. Key determinants from the survey include increased prescription and sale of opioids, a combination of strong opioids with other legal, illegal drugs, and social and demographic factors. The authors further affirmed that the determinants operate independently but in complex situations, they interact with each other. The healthcare system, physician, patient, and social environment played a key role in promoting opioid-related deaths across Canada and USA (King *et al.*, 2014).

A distinct feature of the study conducted by June *et al.* (2016) was on the analysis of the various ages and their relationship to opioid positivity. The research indicated that drivers aged between 21 and 40 years had a significant reduction in opioid use because of operational medical marijuana laws in the state. Adoption of medical marijuana laws has an effect of reducing fatalities amongst drivers as result of reduced opioid use and overdose (June *et al.*, 2016).

Haegerich *et al.* (2014), reviewed the effect of state policy & systems on their ability to intervene prescription opioid deaths. The study focused on the various aspect of state policy towards control of opioids such as the legislations, health guidelines in handling opioid-related cases and distribution of naloxone. The study established that the state policy interventions were inadequate or limited to affect patient's or prescriber's behavior (Haegerich *et al.*, 2014).

The prescription of opioid drugs has been associated with increased risk of patient abuse or misuse. These medications are associated with an increased risk of addiction, misuse, or diversion which has a negative impact on the overall healthcare system. Prescription opioid misuse or abuse is also associated with increased healthcare expenditure and excessive healthcare utilization (Hahn, 2011). In most cases, patients with chronic pain are prescribed to opioids for symptomatic pain relief. However, prolonged use of opioids increases the risk of abuse, addiction, or misuse by patients. Thus, controlling or minimizing prescription of opioids among patients with chronic pain can reduce the risk of abuse. The most advanced strategy to control and prevent opioid abuse is the development and implementation of a PDMP, wherein the detection of physician or pharmacy shopping, physician-patient contract for opioid treatment, identification of inappropriate prescription, urine drug toxicology, referrals to pain/addiction specialists, and provisions for safe disposal of opioids is made available to patients, pharmacists, and physicians (Hahn, 2011).

In the past decade, there has been a significant increase in prescription opioid abuse. To prevent and control such a public health issue, pharmacist have recommended the development and implementation of a PDMP across states. The deployment of a universal PDMP program can help combat controlled substance misuse. A well-developed and structured PDMP can help various stakeholders such as physicians, pharmacists, and even patients benefit from prescription opioid abuse or misuse. The use of a government enforced PDMP can help to fight against opioid misuse in several countries. However, awareness and knowledge of such PDMPs is a critical factor in its wide-spread acceptance and utilization (Fleming *et al.*, 2013).

There has been significant increase in overall opioid sales in the USA and around the globe in the last decade. However, the increased sales or prescription opioids has been associated with increased emergency cases, morbidity, and even deaths due to overdose. Thus, it is critical to develop a robust and integrated program or system that helped reduce misuse or abuse of prescription opioids. The proposed development and implementation of PDMPs is said to decrease the overall morbidity and mortality associated with prescription opioid abuse. In a recent report, a team of researchers indicated that the implementation of a state-based PDMP was associated with an average reduction of 1.12 opioid-related overdose deaths per 100,000 populations. Key factors that contributed to reduced rates of overdose include excessive monitoring, increased review of physician-patient opioid prescription, control over patient safety and prescription errors, and

increased safety on disposal of unused opioids. It was estimated that the implementation of the PDMP would decrease an estimated 600 overdose-related deaths by 2016, which is approximately 2 deaths per day (Patrick *et al.*, 2016).

Jones *et al.* (2015) examined both the national and state trends in opioid agonist medicalassisted treatments (OA-MAT) by focusing on Substance Abuse and Mental Health Service Administration (SAMHSA) data to generate the previous year's opioid abuse by individuals. The key factors that were curial to achieve the objective of the survey includes the potential of buprenorphine treatment, the number of individuals receiving methadone at opioid treatment program and the number of opioid medical-assisted treatment programs operating at 80% or more capacity (Jones *et al.*, 2015).

According to the research, the American rate of opioid abuse stood at 891.8 persons per 100,000. In addition, the patients that received buprenorphine stood at 420.3 at the opioid treatment program while those that received methadone were 119.9. Only 38 states in the US operated their opioid treatment programs at 80%. The findings drawn from the study identified various gaps in the opioid treatment programs and those new strategies ought to be developed to boost the number of OA-MAT providers (Jones *et al.*, 2015).

The research is useful as it tries to identify the extent of opioid abuse within the US. Besides, it compares to the extent of coverage of various agonist opioids medical-assisted treatments that are aimed to combat addiction and abuse of opioids. In short, the study concentrates on the population coverage of medical-assisted treatments of opioids which crucial to the control of substance abuse.

A study conducted by Harlow and Browne (2013) showed that clinician plays a crucial role in facilitating access to opioid-replacement therapy (ORT). The study also revealed that the number of individuals seeking ORT was on the rise across Australia. Out of the 46,446 individuals investigated in 2011, over 64.85% were treated through general

practitioners, 27.3% of the individuals enrolling in ORT programs were public funded. The remaining 7.2% were managed through correctional services. The results of Harlow and Browne research show that individuals have increased the uptake of ORT programs (Browne, 2013).

The need to develop and implement a national prescription drug reporting program is a critical component to reduce the burden of controlled substance abuse related morbidity and mortality. In the US, the development of a national prescription drug reporting program received positive claim from policy makers, public health leaders, the physician community, and the pharmacist association. The rate of opioid-related abuse and addiction would be reduced with the implementation of the national prescription drug reporting program (Shepherd, 2014). Likewise, the development of a national-level universal prescription drug reporting program can help reduce the nuisance associated with opioid abuse and addiction.

Pharmacists, physicians, and nurses play an active role in assessing, educating, and training patients on issues related to drug abuse and addiction. In a recent report, a team of experts indicated that pharmacists in Riyadh had focused on drug monitoring and patient education with an aim to reduce the risk of opioid abuse or misuse. In an estimated 51% hospitals, pharmacists are known to have documented medication therapy monitoring activities while more than 70% of hospitals are known to have an adverse drug event (ADE) reporting system. In an estimated 44% of hospitals in Riyadh, 44% of pharmacists were known to provide medication education to inpatients. However, there is scope for further improvement in drug monitoring systems in Saudi Arabia (Alsultan *et al.*, 2013). In a recent report, a team of experts also has cited the importance of Pharmacy Information Systems in the Eastern province of Saudi Arabia. Although the Pharmacists due to lack of awareness, motivation, and attitude. However, the

information system is widely used to collect, store, and assess patient administration records while it is barely used to monitor pharmacy stock or inventory (Mahalli *et al.*, 2016).

Another recent review reported significant changes in treatment and management patterns for substance abuse disorders in Saudi Arabia. An estimated 83% of adults (20 to 39 years) actively participated in rehabilitation facilities. However, more than 81% of adults were known to have a low level of education and unemployment. Although adults with substance abuse disorders may lack basic knowledge on their health conditions, lack of a formal drug information system and community-based interventions led to increased risk of substance abuse. However, there has been a significant improvement in treatment trends, specifically among treatment-seeking patients (AbuMadini *et al.*, 2008).

Internationally, various measures have been put in place to reduce the risks of opioid abuse. In the US, PDMPs have been established as the policy intervention to respond to the epidemic of opioid analgesic misuse (Brady, *et al.*, 2014). The United States government provides grants to health care providers seeking to establish or enhance automated databases installed for monitoring controlled substances dispensing. Such provisions are important in enhancing interoperability among the systems due to subsidized costs of acquiring effective HIS. The implication is that the United States has a nationwide approach to automation of drug monitoring to avoid misuse of opioids (Reifler, *et al.*, 2012). However, studies have indicated various results of the impact of state PDMPs, although, some have shown implementation of the technological intervention led to significant drop in opioid claims (Rutkow, *et al.*, 2015; Birnbaum, *et al.*, 2011; Kolodny, *et al.*, 2015).

2.4 Research Theories

The thesis aims to establish detailed information and valid reasons of HIS's necessities or mandatoryness in the context of Saudi Arabia. With the process of the applied theory, this study presents a suitable framework for HIS which not only applicable in the Saudi Arabia but also in any of the modern society. Principles of socio-technical theory focuses and involve interactions between people and technology in work environment, and since it has been founded on the basis that the interaction of technical and social functions smoothly helps in the successful performance of the organization. It would be distinct to apply in understanding a complex work process of a HIS. Therefore, researcher is adopting this theory to understand the relation between participants (social part) and the current use of HIS (technical part) during the observation stage, also researcher applied this theory to help design the survey and interview questions, guide selection of relevant data, interpret data and suggest explanations of observed phenomena while considering the joint optimization of both social and technical elements of the environment studied.

Most of the current health statistics are always altering due to ongoing issues affecting the health sector globally. Theory predicts the correlation among various variables. What if there is only one variable which has not occurred before? These changes are mostly unpredictable due to the evolving technology, which is influencing how medical and health problems are offered (Farrington, 2017).

2.4.1 Socio-technical theory

The word Socio-Technical system was first used by Eric Trist, Ken Bamforth, and Fred Emery while studying on workers at a coal mine. Socio-Technical system theory is a set of principles to help with complex work design involving interactions between people and technology in a work environment. It can also be applications of certain principle to manage interactions between complex infrastructure needs and people. It has been founded on the basis that the interaction of technical and social functions smoothly helps in the successful performance of the organization. If only technical aspects are cared for and social aspects ignored, then the organization may fail to achieve its goal or if an only social aspect has been taken care and technical aspects cared then also the organization may fail to deliver on its set goals.

2.4.1.1 Principles of socio-technical theory

The central principles of this theory were noted in a paper: Human Relations (Trist & Bamforth, 1951). These principles were explained by them using case studies. These principles are as follows.

- Responsible Autonomy it meant that groups serving one function can be considered as one unit and they would have autonomy but limited autonomy to manage their relationship with other groups.
- Adaptability The organization should be tailored to manage environment uncertainty. Organizations fail due to internal structural problems rather than environmental issues (Carvajal, 1983). The internal complexity of organization may be increased to manage external complexity, and this complexity may be managed by information systems (Sitter *et al.*, 1997). Human redundancy may be avoided by having a particular skill set people for individual functions (Clark, 2005).
- 3. Whole tasks a particular function has to be assigned to a particular group for greater accountability. This theory states that though it is necessary to instruct what to be done, the team or group should have the freedom to do it in the best possible manner (Cherns, 1976).

4. Meaningfulness of tasks - The autonomy provided and with whole tasks, the teams are empowered and can find their work to be very meaningful in terms of role in creating impact through the system.

2.4.1.2 Application of socio-technical theory for HIS

The socio-technical theory would apply in healthcare settings that the functions would be distinct particularly when new HIS would be designed. The distinct functions would be of social type and technical type.

The functions of technical type include -

- i. Design of the User Interface
- ii. Design of Database
- iii. Implementation of Logic
- iv. Deployment of the HIS on cloud servers

The functions of social type include -

- i. End goals of the system
- ii. Fields to be exchanged between healthcare organizations
- iii. Criteria to send alerts to patients
- iv. Collaboration with government regulators

The distinct social and technical type functions would be related to the system interaction with the real world where doctors, patients, and other healthcare organizations need to use the system to meet their requirement. At the other end would software engineers, database engineers and data operators along with network teams would be enabling the software system. The interaction between both the team can be understood from this theory, and the application of its principles can optimize workings. The design of the system and the team required for the system can be divided into social and technical. The two teams handling the two parts must be given autonomy as listed in socio-technical theory principles. This means that the social side would be empowered to give their requirements and complain about their grievances to improve the system. According to the socio-technical theory adaptability principle, the software system and organization design can be broken into modules and teams, respectively. This would better help us in managing the complexities of external environments.

We can also apply the principles of the whole task and meaningful work by giving the groups responsible for separate activities including design and update of software, managing database operation, managing relations, and getting feedback from health organizations and giving customer support.

2.5 Health Information Exchange and Interoperability Technology

HIE is a major invention in the health care sector that has great importance. It has brought various benefits to hospitals in general. For instance, HIE has led to improved diagnoses hence quality healthcare. In this case, medical errors such inaccurate or incomplete diagnoses have reduced reporting to a good patient outcome and quick response. When medical errors are done away with, care providers can lead a safe life. An organization can identify infectious disease and outbreaks, put the best measures in place hence decreased health care costs (Peden, 2012).

2.5.1 Health information exchange definition

HIE is the transfer of patient's health information among different organizations within a region, community, or hospital system electronically. Nurses, doctors, pharmacist, and other medical practitioners can share and access important and crucial medical information about their patients (Menamechi & Singh, 2012).



Figure 2.13: Symbol of HIE

2.5.2 Interoperability definition

Interoperability is a process in which different information technology systems communication through software applications. It also involves the data exchange and the use of details that have been exchanged. Interoperability helps in removal of same records and increases the efficiency of the medical staff members (Barangiu, Dragoicea, & Novoa, 2016).

Interoperability is also defined by HIPAA as the ability to exchange and use information (usually in a large heterogeneous network made up of several local area networks). Interoperable systems reflect the ability of software and hardware on multiple machines from multiple vendors to communicate.

2.5.3 Interoperability and health information exchange tools

Interoperability is a requirement for effective deployment of health information technology such as prescription drug monitoring systems (Jardim, 2013). The benefits of health information technology cannot be realized if there is no infrastructure that encourages the secure exchange of health information beyond a single provider and

system of healthcare delivery. The exchange allows the electronic sharing of patient-level information across hospitals and health information technology products using interoperability standards that are recognized nationally. HIE allows providers to access, correct and complete information on patients and hence enhance the safety and quality of care (Jardim, 2013). The absence of interoperability is a barrier to the exchange of health information across hospitals because of the fragmentation of the health care system (Noumeir, 2012).

Health Level Seven, a part of the American National Standards Institute (ANSI) that runs in the healthcare sector. Health Level Seven brought into existence and maintained the HL7 Standard. HL7 is the most extensively used application data standard in the healthcare information industry (Weaver, Ball, Kim, & Kiel, 2016). HL7 Standard has different versions–Versions 2 (V2). V2 is an inquiry language database that enables the healthcare providers in sending messages that request and contain health information (Indrasiri, 2016). CDA (Clinical Document Architecture) is another version of HL7. CDA is a program that contains the model of exchange for clinical documents, such as patient's advancement information, transfers, and discharge notes. The V3 was created in 2005. V3 was mainly innovated to solve some challenges faced when using V2 (Kasthurirathne *et al.*, 2015).

Using HL7 comes with various advantages. For instance, health care providers can realize and analyze the importance of the accessible and existing systems. This means that the health provider will not then reinvest in new technologies hence lowering the costs, saving on time. The life and efficiency of current systems are also increased. This, in addition, gives the chance to connect to other systems that are not within the immediate reach of healthcare provider (Benson, 2012). Secondly, HL7 communication easier, and this leads to improved quality workflow since medical experts focus on the main and important business and provide a high-quality healthcare. Instead of writing description every time a patient comes to the hospital and sending data between two systems from the start, medical providers can refer to the stored information hence a uniform understanding (Barangiu, Dragoicea, & Novoa, 2016).

Another advantage of HL7 is that it cuts down the cost for healthcare facilities given that HL7 is a standard interface that is used widely. The implication is that all healthcare service and solution providers should be able to admit the existence of HL7 and integrate it (Barangiu, Dragoicea, & Novoa, 2016).

SNOMED CT is another important tool that is widely used in interoperability. SNOMED CT provides for consistent information interchange and is fundamental to an interoperable electronic health record. SNOMED CT software that provides codes such as words and letters, synonyms, and meanings of terms used in clinic record keeping and reporting. SNOMED CT is preserved and provided by SNOMED International. Other SNOMED CT software tools include SNOB-a browser that is used to correct and add explanations. Snofyre, on the other hand, creates SNOMED CT applications in Java. Apelon DTS is consists of linked components that provide terminological services (Elkin, 2012).

SNOMED CT has various benefits. It enables clinical information that is crucial to be noted down consistently and in a uniform representation in case of consultations. Secondly, SNOMED CT removes language barrier among the people involved. SNOMED CT ensures early recognition of emerging health issues, checking population health and responses to change and given clinical practices and guidelines. SNOMED CT allows proper and extensive searches that in return identify patients who would need changes undertaken to provide effective treatment and follow-up based on the providing of the revised guidelines (Benson, 2012; Elkin, 2012).

Recently, FHIR (Fast Healthcare Interoperability Resources) is the enhanced HL7 version. FHIR is the other version of HL7. It is a composition of HL7 V2, HL7 V3, and CDA. FHIR is a version that makes health care applications uncomplicated, orderly, quick, and even easier to write (Kasthurirathne *et al.*, 2015). FHIR is a new specification based on emerging industry approaches. FHIR aims to simplify implementation without sacrificing information integrity. It leverages existing logical and theoretical models to provide a consistent, easy to implement, and rigorous mechanism for exchanging data between healthcare applications (HL7.org, 2011). The emerging use of the FHIR Standard unlocks the holy grail of interoperability; it breaks down information silos, enabling appropriate sharing of high-quality healthcare data, and images amongst the patient's multidisciplinary care teams wherever they may be (Hobson, 2017).

Foley (2017) states FHIR is considered as the innovative step in bringing effectiveness in the working of healthcare organizations. The combined efforts of IT professionals and healthcare managers have emerged out different solutions that can resolve the issues faced by clinical and hospital management. Rathore (2016) also describes the importance of sharing of relevant and useful information within the healthcare sector. The information exchange process has become easier for the management of healthcare institutions to maintain and review the records of patients easily. The main reason for introducing FHIR was to bring a positive change in the HIE's in the United States.

Slabodkin (2015) also highlights that advancement is FHIR in the form of application that will help in maintaining electronic health records. The health data management is controlled and managed through this application that will include an application programming interface on FHIR applications. Tillery (2014) discusses the requirement of

modification and development in FHIR system that IT professionals intend to achieve the desired objectives. FHIR was the initiative that was introduced and designed to allow customization of connections among different healthcare institutions and departments.

Gardner (2016) mentions the importance of FHIR by presenting the efforts of Micky Tripathi, who was the frontman in introducing FHIR in the healthcare sector of the United States. The major reason for introducing and implement FHIR standard was to reduce the effort of employees working in healthcare sectors. The requirement was to modify records in a way that concerned people (healthcare employees) could easily get the information without wasting time in reviewing long reports of patients. In other words, efficiency and accuracy were the primary objectives of implementing the standards in healthcare institutions.

Henderson (2016) explained that the FHIR standard has made it easier for staff to maintain electronic records that help in ensuring high efficiency of hospital staff. These amendments and modification in the entire health sector or their related standards are to improve the performances of doctors, nurses, and other staff. Bloomfield Jr, Wood, Mandel, and Mandl (2017) recognized the need for EHR to be highly interoperable. In their study, they had demonstrated the first successful implementation of a standard API layer on their EHR including the integration of multiple clinical systems. They found that the deployment and use of technologies such as FHIR and SMART in live clinical systems are feasible and ready for widespread clinical deployment. Although FHIR is still in trials by different health care organization and vendors, this study will be applying FHIR standards as the interoperability tool to grant a real time information access and exchange.

Pfiffner, Pinyol, Natter, & Mandl (2016) highlighted that the continuous changes and modifications are required in the healthcare sector to ensure high effectiveness. The

management of healthcare institutions and officials of healthcare authorities have introduced innovative ideas using advanced technologies and equipment to maintain consistency regarding development in the overall sectors. The responsibilities and obligations of hospital staff are managed and controlled by authorities and professionals working in the healthcare field. Demski, Garde, & Hildebrand (2016) also explained that continuous development is the essentiality of healthcare. The collaboration and communication of healthcare and IT professionals are also helpful in ensuring development in the operational activities of healthcare and medical care. However, the FHIR standards should be followed accordingly to maintain consistent development in the facilities provided to patients.

2.5.4 Health information exchange importance and benefits

Sweileh, Zyoud, Al-Jabi, and Sawalha (2014) examined research on substance abuse in Arab countries and found that Saudi Arabia had a lot of studies on the issue. However, research on the use of an interoperable prescription drug monitoring program in Saudi Arabia is limited and hence the increased rates of abuse of controlled substance such as opioids. The lack of an interoperable HIS has hindered sharing of patient health information on opioids use with other healthcare providers and pharmacists in different health organization. As a result, more research on the use of an interoperable prescription drug monitoring system to prevent opioids abuse is needed as well as a specific organizational HIS integration with PDMP to bridge the literature gaps.

2.5.5 HIE privacy and security

The fundamental function of HIE is to allow clinical information access whenever demanded by a healthcare facility. It gives consent for the exchange of health information electronically between unique information systems for healthcare while at the same time ensuring the integrity of the information shared (Roberts, Staff, & Jones, n.d.). This is

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important as it creates trust between the patients and the healthcare providers. It is therefore important for the HIE to set up and implement policies as well as procedures that guide operations, especially how health information would be maintained and protected. This led to the creation of the "Health Insurance Portability and Accountability Act" (HIPAA) which regulates the exchange and use of healthcare information (Annas, 2003). The HIPAA protects all health information that is identifiable which is also referred to as protected health information, obtained or made by a covered entity.

Below is a detailed specification of the HIPAA policies regarding patient privacy and information security as well as the Saudi HIE policies applied locally in parallel with the HIPAA ones.



Figure 2.14: etailed Specification of the HIPAA Policies

2.5.5.1 HIPAA's health information exchange policies

HIPAA requires that a covered entity does not give out protected health information without the individual involved, giving permission for treatment, health care operations or payment (Secretary & OCR, 2013). It is a requirement of this act for an individual to give authorization for the use of this information through writing with contents in the written consent. However, it provides some exception to this requirement such as disclosure to an individual's associates in business, for research purposes as well as to the state, among others.

The act also confers rights to a person concerning protected health information. It gives the people the right to be notified of the privacy practices by a healthcare facility or even a health plan that informs them about the anticipated disclosures and uses of information on their health (Kulynych & Korn, 2003). This is especially on the information that would be disclosed without the authority of the patient. The act also gives patients the right to obtain and see duplicates of the information on their health, request for the correction of health information they deem incorrect or incomplete as well as being given an account of specific disclosures that the entity would have done in the past years.

The act also allows the utilization of the protected healthcare information for research purposes, and this may be done voluntarily by the individual. However, for this to be valid under HIPAA, the authorization from the individual must be "specific and meaningful" (Secretary & OCR, 2017). This implies that the person must give a comprehensive rendition of the information they are giving out for use in research. The language used must also be plain with the core elements as the contents as well as statements explicitly addressing patient's rights to revoke the authorization (O'herrin, Fost, & Kudsk, 2004). The act also allows a research entity to obtain protected health information with a patient's consent to be used in future studies. This permits the storage of health information as well as the biological sample in the electronic database.

The HIPAA also allows for the integration of protected health information data between different healthcare providers for the purposes of healthcare operations only (Mercuri, 2004). This is to allow the provision of the complete picture of the patient's information on their current health conditions as well as the historical health background. The data integrated between the healthcare providers should be disclosed and used in a coded manner so that the process become ease in linking data from a patient longitudinally over integrated setting (Steinbrook, 2008). However, this provision does not allow the disclosure of the integrated information to research entities unless through an authorization waiver by privacy board as obtaining authorization of individuals with integrated information from several facilities would be unrealistic.

HIPAA also gives the rights to individuals to demand accountability of disclosures by covered entities. It gives patients the right to be furnished with a list of the disclosures that have been done on the protected health information in the previous six years and how the information has been used between different entities. The accounting for the disclosure and use must contain comprehensive information on appropriate disclosures including the dates, identity of the recipients of the health information, the explanation of the disclosed data, and a statement of purpose for the disclosure (Walker *et al.*, 2005).

The HIPAA regulations have set out criminal and civil consequences for the covered entities for the violation of the act. It sets fines and prison terms for the violation as well as suspension of operations for the entities for various violations (Kilbridge, 2003). However, it does not allow an individual patient to initiate criminal proceedings on an entity that has breached their privacy on the protected health information. They can only file claims with the Office of Civil Rights who would initiate the proceedings.

In addition to the HIPAA act standards mentioned above, the health insurance portability and accountability act has set various guidelines to be adhered to when dealing with electronic medical and clinical data. These guidelines emphasize on considering all measures by care providers, health organizations when saving, accessing, and sharing any medical clinical data to maintain the patient information security. Some of the HIPAA security compliance steps that need to be considered when adopting a medical electronic record include the following:

- Run a complete risk assessment of the medical practice
- Prepare for disaster before it occurs
- Have an ongoing employee training program
- Buy medical products with security compliance and compatibility in mind
- Collaborate with affected parties

2.5.5.2 Saudi HIE policies and guidelines

Saudi Arabian health council represented by the national center for health information had set a national policies standard driven from the international HIE standards including HIPAA acts standards to regulate and control HIE among different health care settings in Saudi Arabia. These policies would facilitate and allow the flow of patient personal health information when needed wherever patient is in the kingdom. It is also a part of the prerequisites of the unified medical record project going on in the kingdom of Saudi Arabia that facilitate the access to the patients' electronic charts all over the kingdom to promote patient care services rendered and practice a safe clinical management in the region.

The below statements summarize the Saudi HIE and interoperability standards and policies as well as the purpose of each policy. The standards are always under revision and continuous update by the national center for health information teams. These policies include the following:

1. Saudi HIE purpose of use policy:

Personal Health Information (PHI) will primarily be made available on the Saudi HIE for purposes of Treatment, Healthcare Operations, and Public Health.

The purpose of this policy is to define the permissible uses of the Saudi HIE such as patient care, public health, and quality. This policy applies to the Saudi HIE, and to all individuals and organizations who have access to the Saudi HIE managed health records.

2. Saudi HIE information security policy:

Participating health care subscribers (PHCSs) shall implement policies and protections for Access Control, Automatic Logoff, Audit Log, Emergency Access, Integrity, Authentication, and Encryption. A list of policies and protections shall be requested and checked when onboarding participating sites. A minimal set shall be specified in the policy, and additional requirements may be included in the Data Use Agreement. All Saudi HIE system components should be managed and operated in conformance with the ISO/TC 215 standard: "ISO 27799:2008, Health informatics --Information security management in health using ISO/IEC 27002". Data Shallotte deleted at any time from the Saudi HIE. Data MAY be amended to accommodate corrections. All Saudi HIE Systems shall be managed in accordance with one of: ISO 27000, SAS70/ SSAE 16, supporting physical safeguards, clearance, access, supervising those with access and other core secure management practices. All Saudi HIE systems shall implement contingency and disaster recovery plans to assure availability and integrity of Saudi HIE managed health information. Retention time for Saudi HIE managed PHI is indefinite. All Saudi HIE systems shall implement intrusion detection measures. The Saudi HIE and the PHCSs shall require personnel training in privacy and confidentiality for all personnel handling health information that is directly or indirectly involved in the support of Saudi HIE systems. A privacy/security officer shall be designated at the Saudi HIE, as well as in the PHCSs. The Saudi HIE and the PHCSs shall implement a personnel sanction policy for inappropriate use, transmission, copy, or disclosure of Saudi HIE information and services. PHCSs should have contingency plans in place for extended downtime periods.

The purpose of this policy is to ensure that the information security is conducted in a manner that protects personal health information and supports the availability, confidentiality, integrity, and accountability of the Saudi HIE shared clinical information.

3. Saudi HIE subject of care rights policy:

The Subject of Care or the Subject of Care Agent shall be able to access the Subject of Care's relevant personal health information contained within the Saudi HIE. The Saudi HIE should make information available to Subjects of Care regarding how their personal health information could be used, who could have access to it, and under what circumstances it could be disclosed. Implementation of the HIE should be accompanied by a significant education program so that individuals understand how the network will operate, what information will or will not be available on the network, the value of the network, its privacy and security protections, how to participate in the exchange and the rights, benefits and remedies afforded to them. These efforts shall include outreach to those without health insurance coverage. Each Subject of Care may receive information generated by the PHCS from their provider explaining the Saudi HIE services and the Subject of Care's rights regarding use and disclosure of PHI from the Saudi HIE systems ("Special Notice") at the Subject of Care's first visit following the provider's participation as a Saudi HIE's PHCS. PHI maybe shared unless the Subject of Care opts out of the Saudi HIE. All efforts shall be taken to implement and maintain systems for HIE that protect the integrity, security, privacy, and confidentiality of a Subject of Care's information. The governance of the Saudi HIE shall be transparent.

The purpose of this policy is to define Subjects of Care and healthcare consumer expectations that will govern the design and implementation of the Saudi HIE Systems.

4. Saudi HIE identity management policy:

Healthcare Organization (e.g., hospital) and Business Associate (e.g., supporting quality management Organization) systems connecting to the Saudi HIE systems shall be subject to Trusted Third-Party Attestation for the issuance of organization system digital certificates. Self-signed certificates or those issued by another PKI shall not be used. Individual users accessing the Saudi HIE systems shall be subjected to Trusted Attestation for the issuance of identity credentials. Digital certificates used for authentication or digital signatures shall be issued by the National Center for Digital Certification. Federated identity providers may apply to authenticate users to the HIE on a case-by-case basis. The purpose of this policy is to ensure that the identities of the individuals and entities interacting with the Saudi HIE are assured to enable a data processing system to recognize entities. Electronic identity credentials shall not be issued until an agreement addressing the credential holder's requirements is completed and signed. This may for example include an agreement to terms and conditions for online registration processes for individual users. Procedures for account revocation upon employee severance for any employee who was issued an individual identity credential to access the Saudi HIE systems shall be implemented by the PHCS. Procedures for account update upon employee role modification for any employee who has been issued an individual identity credential to access the Saudi HIE systems, shall be implemented by the PHCS. Subscriber (NIST 800-63-1) agreements SHALL include the requirement to protect the Subscriber identity credential. Subscribers (NIST 800-63-1) shall notify a Saudi HIE authorized Registration Authority if their digital identity is lost, stolen,

or otherwise known to be compromised. This will result in a revocation request and request for a new digital identity.

The purpose of this policy is to ensure that the identities of the individuals and entities interacting with the Saudi HI are assured to enable a data processing system to recognize entities.

5. Saudi HIE Authentication policy:

Emergency Access must be supported by all HIE node systems accessing the Saudi HIE as a break-glass with audit and review of these actions, in accordance with the Audit Policy. Notification to the subject of care in the event of break-glass access should be provided by the Security and Privacy Officer of the Saudi HIE. Automatic user logoff shall be supported by all HIE nodes accessing the Saudi HIE. The user sessions of the HIE node should be automatically logged off after no more than 30 minutes of inactivity. All HIE Nodes exchanging personal health information shall implement a node authentication mechanism compliant with Transport Layer Security (TLS) [Internet Engineering Task Force (IETF): Transport Layer Security (TLS) 1.0 (RFC 2246)]. All Saudi HIE system remote access by individual users shall require multi-factor authentication. PHCSs should assert multi-factor authentication for remote access to their systems (from outside of the physical control of the organization) if the accessed system enables access to the Saudi HIE. A Registry of PHCSs within the Saudi HIE may include primary contact information of registered members, roles/privilege information, and identity attributes of providers, organizations, and systems. The primary contact information for the data in the directories supplied to the Registry should minimally include a primary contact name and any associated contact phone numbers. The Saudi HIE shall require unique identification of the individuals (employees, care

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providers, subjects of care, subjects of care agents), systems (HIE node, HIE system, or the Application), and Organizations accessing the information in the Saudi HIE. The user identity, role, and affiliation must be checked for both revocation and expiration at the time of logon to the system. If any of these has been revoked or has expired, access shall be denied. Any system providing access to the Saudi HIE shall be responsible for verification of credentials.

The purpose of this policy is to ensure that systems and individuals interacting with the Saudi HIE systems are known through the process of reliable security identification of subjects by incorporating an identifier and its authenticator.

6. Saudi HIE secondary use policy:

Both local PHCS and HIE designated IRBs shall comply with the regulations as presented in the document titled "National Committee of Bioethics Implementing Regulation of Law of Ethics on Living Creatures". This document is produced by King Abdul Aziz City of science and technology. Personal health information on the Saudi HIE may be made available for purposes other than Treatment, Operations and Public Health, as defined in the Purpose of Use Policy. Deidentified health information may be released from the Saudi HIE under the conditions detailed in the policy details. The Saudi HIE shall make available a record of all approved requests for identified PHI, de-identified health information, anonymized health information, and pseudonymized health information from the Saudi HIE.

The purpose of this policy is to establish the conditions, if any, under which personal health information on the Saudi HIE may be used for purposes other than direct patient care (as defined in the Purpose of Use Policy).

7. Saudi HIE consent and access control policy:

HIE node applications must have successfully completed access control testing conducted by Saudi HIE approved bodies. Applications that have not yet completed this testing may be considered on a case-by-case basis. Access to personal health information (PHI) through the Saudi HIE systems requires verification of consents managed according to this Saudi HIE Consent and Access Control Policy. When the Saudi HIE is used for purposes of treatment, the health professional seeking access should have a treatment relationship with the Subject of Care. Saudi HIE shall define the Specific Personal Health Information that shall be made available by each HIE node. All relevant information flows to the Saudi HIE, except where law or policies of the PHCS prohibit it. Such PHCS policies that would be in effect shall be disclosed to the HIE during the on-boarding process. All new policies established by the PHCS after they join the HIE shall be disclosed to the HIE. If the policy is not acceptable to the HIE, the HIE may suspend access to the HIE. In the case where the Subject of Care has opted out of the Saudi HIE, all relevant information shall continue to flow to the Saudi HIE. Once the Subject of Care has opted out of the Saudi HIE, access to information/documents related to that subject of care shall be restricted to emergency situations, only physicians should be able to force access to all the data, including data for a Subject of Care that has opted out of the Saudi HIE, by "breaking the glass", which should trigger notification and after-the-fact review. Access controls enforcement, including verification of Opt-Out status, is performed at the time of use and disclosure. The individual that accesses the PHI must be responsible for protecting that information or disseminating that information. Sensitive personal health information/documents that are afforded special protection above and beyond protections afforded to generic Personal Health Information must be marked. The Saudi HIE may offer transformation services to assist the PHCS with the identification of sensitive PHI based upon information source on a case-by-case basis. The method of transformation shall be approved by the Saudi HIE governing body.

8. Saudi HIE audit policy:

All Saudi HIE systems and HIE nodes shall implement technical processes that accurately record any activity related to access, creation, modification, and deletion of electronic PHI. The Saudi HIE systems shall support interoperability requirements conformant to ISO 27789 Audit Trails for EHRs (e.g., IHE Audit Trails and Node Authentication, ATNA). The HIE nodes exchanging PHI should support interoperability requirements conformant to ISO 27789 Audit Trails for EHRs (e.g., IHE Audit Trails and Node Authentication, ATNA). As a part of login monitoring, an audit log must be created to record when a person logs on to the network or a software application of the Saudi HIE. This includes all attempted and failed logons. Audit logs should either be in human readable form or translatable by some easy-to-use tool to be in human readable form. Audit logs should be retained for the same duration as the retention time required of Saudi HIE managed PHI. All HIE node systems and Saudi HIE systems shall be configured to generate logs of all events (e.g., login, logoff, access events, denial events, etc.) as supported by installed products to enable further investigation and traceability. Audit logs repository must be secured in accordance with the Saudi HIE Information Security Policy. Access to system audit log analyzing tools and audit logs must be safeguarded to prevent misuse or compromise. Saudi HIE audit logs access shall be restricted only to privacy and security officers approved by the Saudi HIE governing body.

The purpose of this policy is to ensure that the security and confidentiality of Subject of Care data transmitted through the Saudi HIE are monitored/tracked through privacy or security audits.

9. Saudi HIE breach notification policy:

The Saudi HIE privacy and security officer or designee shall monitor PHCSs access to the Saudi HIE at least monthly by reviewing the Saudi HIE systems audit reports. The Saudi HIE privacy and security officer SHALL contact the PHCSs to review any suspicious activity. In case of a Reportable Event, the privacy and security officer of the PHCS shall investigate the suspicious activity and generate a report of the event (see Section 10.3.2). The Saudi HIE and PHCSs are obligated to create a notification of all Reportable Events involving the PHI managed by the Saudi HIE. Subject of care-initiated notification of Reportable Events may be accepted by the Saudi HIE privacy and security officer. The Saudi HIE shall establish and publish a process for filing reports to inform and guide those required or eligible to file Saudi HIE related Reportable Events. This process will consider the private nature of Subject of Care reportable events. All reports shall follow the process. Breaches involving a single Individual and breaches involving small numbers of individuals should be reported to the Subject of Care. Breaches affecting large numbers of individuals, typically more than five hundred and involving continuous risk, should be reported publicly. Such decision shall be made by the privacy and security officer in collaboration with the Saudi HIE governing body and law enforcement authorities. Public notification of a breach shall include the time and date of the breach occurrence and the identification of everyone whose PHI is involved. If a breach occurs at the PHCS, then any required public notification is the responsibility of the PHCS. If the breach occurs at the Saudi HIE level, then the responsibility is of the Saudi HIE to report the breach, or, in some situations (e.g.,

where it is determined that it is important for the communication to be initiated by the healthcare provider organization rather than the Saudi HIE), to report to the PHCS, which shall in turn make any required public notifications. Such notification shall be made within thirty (30) days following discovery of the breach. The purpose of this policy is to define policy surrounding identification, investigation, notification, and mitigation of a breach within the Saudi HIE system.

Saudi national center for health information continues to collaborate with other related parties to make sure all policies and guidelines that governs and regulate the HIE and interoperability processes are well monitored, revised, and updated as they meet new challenges for new technologies.

2.6 Prescription Drug Monitoring Programs (PDMP), Definition and Benefits

PDMP is one of the mostly used and expanding programs especially in the United States, mainly to monitor and track prescription drug abuse and diversion. Each state legitimizes the needed rules to have the PDMP work according to their workflows and their own requirements. The expansion of PDMPs state-wise would help monitor the overall prescribing, consumption, and dispensing rates of specific drugs and pharmaceutical products (Simoni-Wastila, 2011). However, there is no clear model or program to access, monitor, or control drug abuse/misuse in Saudi Arabia. There is a need to develop and implement, comprehensive, and integrated PDMP in Saudi Arabia not only to reduce rates of drug/opioid abuse or misuse but to also morbidity mortality, and overall costs. In most states in the US, the development and implementation of PDMPs have become mandatory with an aim to reduce overall burden, morbidity, and mortality associated with prescription opioid abuse/misuse. The rationale for implementing an integrated PDMP in Saudi is to overcome the risk of opioid abuse, misuse, or addiction. Opioid abuse or controlled substance abuse is a major public health issue that increases the overall burden of the healthcare system and the healthcare expenditure (Haffajee *et al.*, 2015). This section provides an overview on various studies, concepts, factors, policies, users perceptions, and benefits associated with PDMP utilization to understand, develop, and enhance robust, integrated, comprehensive information systems for prescription monitoring system in Saudi Arabia.

According to Sullivan (2013), PDMP was developed by a single state legislation few years back. The following PDMP definition is stated by Sullivan (2013) as, "they are tools for reducing drugs abuse and diversion. They consist of statewide electronic databases which collect, monitor, and analyze electronically transmitted prescribing and dispensing data submitted by pharmacies and dispensing practitioners".

CDC (2016) also had defined PDMP as: state-run electronic database used to track the prescription and dispensing of controlled prescription drug to patients. They are designed to monitor this information for suspected abuse or diversion. Data stored in and retrieved from PDMP is used for different purposes, these include research, education, enforcement, and the main goal which is to prevent drug abuse.

In the past decade, only few countries have had a comprehensive PDMP, i.e., USA and France. PDMPs can also be defined as comprehensive and robust electronic databases that are used to collect data on controlled substances, wherein healthcare providers can access information such as drug abuse, doctor shopping, diversion, or other unlawful activities. PDMPs were developed with an aim to reduce overall prescription drug abuse, specifically track, and control unlawful selling activities. The development and implementation of PDMPs in the past 10 years is associated with 4 key themes: (a) The impact of PDMPs on multiple provider episodes and prescribing practices; (c) The impact

of PDMPs on patient characteristics and prescribing practices; and (d) The impact of PDMPs on healthcare provider's prescribing practices and overall perspective on drug abuse/misuse (Worley, 2012).



Figure 2.15: Current Prescription Drug Monitoring System Performance Processes

In a recent report, a team of experts cited the importance of developing and implementing a prescription monitoring program (PMPs) in a bid to control, prevent, monitor, and access information related to prescription opioid use. The use of PMPs may vary from state to state but increasing its accessibility and usability can have a profound impact on reducing opioid diversion and improve overall patient safety (Morgan *et al.*, 2012).

On a global scale, the US has one of the most advanced, comprehensive, and highly utilized and accessed PDMP. The United States' Centers for Disease Control and Prevention has been associated with the development and implementation of several state based PDMPs. In a recent review, a team of researchers stated that the most advanced and critically acclaimed PDMPs were available at West Virginia, Ohio, and Kentucky in the US. The Kentucky All-Schedule Prescription Electronic Reporting System (KASPER) is the most stringent system that focuses on reporting CII, CIII, and some CIV drugs within the system. The Controlled Substance Automated Prescription Program (CSAPP) in West Virginia has forced all licensed pharmacist to report, collect, and stored data for all controlled substance prescriptions (White *et al.*, 2016). Likewise, Saudi Arabia can have its own enhanced PDMP according to the local requirements by passing and standardizing laws, rules, and regulations for all regions. However, the implementation of an integrated universal PDMP can help establish a robust, reliable, secure, and efficient system to combat controlled substance abuse, addiction, or misuse.

The utilization of the PDMP in the US has gained significant importance due to its impact on reducing controlled substance diversion, addiction, or misuse (Gabay, 2015). In Saudi Arabia, the development of such systems can help combat abuse and misuse among patients addicted to prescribed opioids or other controlled substances.

Based on current evidence, the utilization of PDMPs among pediatric physicians and internal medicine physicians is the lowest due to lack of training, knowledge, attitude, and overall preference. The accessibility and utilization rates by pediatric physicians are extremely low due to poor accessibility and awareness. In a recent survey, 30% of respondents (all pediatric physicians) were not aware of their state based PDMP while only 61% of pediatric physicians reported to have used PDMP related services at least once during their practice (Wang *et al.*, 2017). Some of the key barriers for pediatric physicians to avoid or utilize PDMPs include lack of knowledge, poor accessibility, lack of awareness, time, and tendency to forget. Many pediatric physicians and internal medicine providers are not trained or made aware of PDMPs (Feldman *et al.*, 2011).

Like the US, Canada has a well-established drug monitoring program to combat abuse, diversion, misuse, and even addiction. In Canada, there are 4 key programs that have received positive acclaim in the past decade, i.e. The Triplicate Prescription Program of Alberta (TPP-AB), Prescription Review Program of Saskatchewan (PRP-SK), The Nova Scotia Prescription Monitoring Program (NSPMP), and the Prescription Review Program of British Columbia (PRP-BC). Each of these programs are run in their respective provinces, i.e., British Columbia, Alberta, Saskatchewan, and Nova Scoti. The utilization and accessibility rates of each of the drug monitoring programs are different and vary on medical specialty. However, physicians in their respective provinces are aware and knowledgeable of the existing drug monitoring programs (Furlan *et al.*, 2014). Likewise, Saudi Arabia should develop specific drug monitoring programs for each of its regions or develop a universal PDMP that can be accessed and utilized by all physicians, healthcare providers, and pharmacists through an integrated, safe, secure, and reliable network.

Wixson *et al.* (2014) investigates the perception of Kentucky law enforcer regarding PDMP. Substance abuse and prevalence of misuse remain a concern in many states across the US. Over the last decade, a large proportion of US using off-label prescription increased at an alarming rate due to awareness. To regulate off-label prescription and abuse of the drug, over 40 states have enacted a legislation to help review report generated by PDMP. The main aim of developing PDMP, supported with the state legislation act, is to combat fraudulent prescription and monitor controlled substance abuse affecting many states in US. Different states have different legislation act regulating controlled substance abuse. Thus, influences the periodic time required by the law enforcer to review data dispensed containing report of prescription patterns and habits of the physician in medical services (Wixson *et al.*, 2014). Most state legislator nevertheless deems it appropriate to submit a weekly report of the PDMP, but different states healthcare differ on how to schedule their monitoring. They also have different bodies to review their reports such as the regulatory/licensing board.

Report generated with the PDMP is used with the law enforcement to aid investigation of incidents involving drug diversion and cases involving fatal overdose. Before the inception of PDMP, the report availed to law enforcement for investigation; urine tests screen, witness complaint, and medical report statement had to be probable (Wixson *et*

al., 2014). PDMP greatly benefited the law enforcement official. Time spent investigating drug diversion greatly reduced because of faster generation of reports from the PDMP database, which aided rapid investigation. According to an interview (Wixson *et al.*, 2014) conducted to Virginia and Kentucky law enforcement community, before the introduction of PDMP, investigation of drug-related incidents took hour and hours of manual labor reviewing hospital and pharmacy records. Law enforcement official applauds PDMP as a restriction to doctors shopping. Most physicians rely on the database record to make a sound judgement of prescription to their patients. The information from the PDMP database indicates the next prescription date, demography, and history of recent purchases similar medication. Physicians also say most patients are well informed about the information retrieved from the PDMP database, which deters them from doctor shopping thus a regulating factor.

Opioid abuse, overdose, or misuse has been associated with an increase rate of emergency department visits. Medical prescriptions for anxiety, insomnia, and pain have contributed to higher rates of emergency department visits due to adverse effects or risk of death. The rate of emergency department (ED) visits has nearly doubled, i.e., 214 visits per 100,000 individuals in 2004 to 458 visits per 100,000 individuals in 2011 (Haffajee *et al.*, 2015).

Prescription drug abuse is a common public health issue around the globe. In patients with chronic pain, prescription of opioids is associated with significant increase in opioid-related abuse, misuse, addiction, or even death. An enhanced interoperable PDMPs in Saudi Arabia can help emergency care physicians to assess the patient's history of controlled substance use, addiction, or even misuse. Physicians, emergency care personnel, and nurses can access drug information from other facilities through an interoperable PDMPs to assess risk factors associated with a patient's opioid use. Most emergency care physicians are aware of their state based PDMP which can be used as a reference guide to assess risk factors that contributed to the patent's risk for overdose or
death. However, the lack of training and accessibility was reported as a major barrier in the overall utilization of PDMPs. The utilization of PDMPs among emergency care physicians is essential since it helps them identify patients at risk of opioid misuse and assess or suspect if a patient may have misused an opioid or controlled substance other than that for medical purposes (Young *et al.*, 2017).

According to the study done by Katz *et al.* (2008), numerous physicians aware of the risk factor associating the controlled substance and their impact on the economy. They are comfortable assessing the risk factor associated with this controlled substance. The most abused drug is the opioid according to the authors, and there is growing concern to help control and manage its abuse. It also helps improve health care outcomes and by improving the quality of life.

About 20% to 40% of patient prescribed with opioid abuse other types of drug evidence from their urine screen test. PDMP is, therefore, a useful tool for the physician to help them manage and detect incidence that can lead to the abuse of this controlled substance. PDMP helps to detect a possible attempt by the patient-doctor shopping which can lead to addiction to a controlled substance such opioid (Katz *et al.*, 2008).

In a recent exploratory study, comprising of a 24-times survey among emergency physicians, a team of experts reported that PDMPs was a useful and essential tool in patient assessment and risk identification. Emergency physicians utilize PDMPs to assess the risk of patient's abuse, history of controlled substance use, and identification of risk factors that contributed to controlled Davis, improved patient safety in the ED and decrease in overall prescription of opioid abuse (Fleming *et al.*, 2014).

The utilization of PDMPs among emergency care physicians and healthcare providers is the highest. The most critical component accessed from the PDMP in the emergency department is that of patient's history of controlled substance use, abuse, or misuse. PDMPs are a critical tool to access doctor shopping of opioid or other controlled substances. Based on a recent qualitative review, a team of experts reported that emergency care physicians accessed and utilized PDMPs to modify clinical decisions and guide opioid/control substance prescribing patterns. PDMPs help emergency care physicians to develop alternate clinical plans that not only safeguard the patient but also ensure patient safety and prevent risk of abuse or misuse. Emergency care physicians also utilize PDMPs to report cases of opioid misuse, abuse, or addiction which would help the primary care physician or pain/addiction specialist to modify dose, dosing regimen, or alternatives for patient safety and wellbeing (Smith *et al.*, 2015).

From the study conducted by Baehren *et al.* (2010), it is evidence that there has been a substantial decrease in the incident involving the emergency department. PDMP helps regulate controlled substance in the US, which has been a problem for the last decade. Incident such as doctor shopping and diversion were the major contributor to prescription drug abuse in the US. PDMP to a greater degree has reduced the incidents associated with a drug overdose, which led to emergency department admission.

According to Jennifer and Patrick (2011), majority of a physician in Florida applaud for the implementation of PDMP in their state. On the other hand, pharmacists disagreed to the implementation of this program arguing that it would deter drug distribution in the state. They further support their argument by saying that it would also be an invasion to the patient record.

The state of Florida prompts the implementation PDMP to help fight controlled substance diversion, doctor shopping, and drug abuse since it is a threat at core economic performance. Although the attitude of the healthcare providers and the pharmacist is important for the implementation of PDMP, pharmacist was against its implementation. Increased implementation of PDMP and federal state intervention to tremendously reduced controlled substance abuse in major states across the US positively affected emergency department outcomes. More importantly, PDMP is helping more physicians rely on and make precise controlled drug prescription, which is improving the patient outcomes and reducing emergency department visit due to the error associated problems.

Emergency care physicians, nurses, and allied healthcare staff play a vital role in treating and managing patients with drug abuse, misuse, or overdose. However, it is PDMPs that help staff members to assess the patient's profile efficiently. PDMPs often fasten the process of risk identification, treatment, and management of a patient. Opioid addiction remains a critical issue among elderly patients with chronic pain and allied healthcare issues. However, patients with chronic use of opioids or other painkillers often suffer from multiple health complications. In the emergency care unit, physician and nurses have also reported significant issues related to multiple addiction among young adults and elderly patients due to chronic use of painkillers, analgesics, and other medications. Thus, emergency care staff tend to have better clinical knowledge and expertise in assessing and handling drug abuse or misuse patients. However, PDMPs are an added advantage for emergency care personnel to deal with drug abuse or addiction patients (Fleming *et al.*, 2014; and Young *et al.*, 2017).

2.6.1 Other technologies in tracking and monitoring prescription drug abuse patients

In addition to the PDMP, there are several Prescription Drug Monitoring Program systems that are widely being used by health organizations to control the abuse of prescription drugs. These systems are used by different health organizations all over the world and mostly in the United States. All provide a reporting tool to track the controlled substances dispensing patterns to reduce abuse and diversion of controlled substances. The following are some of the most popular tracking systems that works in parallel with the PDMP and exchange information with its data base. These systems include:

1. The Electronic Prescription for Opioids & Controlled Substances

One of the systems is the Electronic Prescription for Controlled Substances (EPCS). This system enables the physicians to write the prescriptions for controlled substances electronically. The EPCS also allows the pharmacists in health care organizations to receive dispense and document the prescriptions.

Carlson and Wormuth (2015) and Brady *et al.* (2014) claimed that the PDMPs are critical in dealing with controlled-substance abuse. According to these studies, shifting to the EPCS is important in health care because it enables the pharmacists to deal with the increased cases of prescription drug abuse. Shifting to the EPCS also enables the pharmacists to be aware and stay abreast of the state laws regarding the drug prescription processes. Through the EPCS, the physicians and pharmacists can send an accurate and understandable prescription that is error-free directly to the pharmacy from the care center.

Kirschner, Ginsburg, and Sulmasy (2014) argued that the abuse of prescription abuse is an epidemic that faces all health care organizations. According to these authors, it is the role of the physicians and the pharmacists to ensure that the patients do not abuse the prescription drugs in health care setting. This study indicates that the physicians can deal with this epidemic using EPCS system to ensure that the physicians accurate prescribe the controlled substances to their patients. According to Kirschner, Ginsburg, and Sulmasy (2014), physicians and other health professionals are entrusted with the responsibility of ensuring that there is a safe and effective use of controlled-substance drugs and deterrence of its abuse. Hillblom, Schueth, Robertson, Topor, and Low (2014) argued that understanding the use and the implications of health information technology in care delivery and prescription of drugs is crucial for the future of managed care pharmacy. According to Hillblom, Schueth, Robertson, Topor, and Low (2014), information and proper prescription are the main aspects of providing and managing care in health organizations. This study indicates that the use of EPCS is critical in preventing prescription drug abuse because it enables the physicians and pharmacists to exchange information regarding the patient for proper prescription easily.

According to Thomas *et al.* (2013), electronic prescription of controlled substances has significantly helped physicians and pharmacists in various countries to manage prescription drug abuse. These authors discuss the perceptions and experiences of several prescribers in Berkshire County, Massachusetts about the implementation, and effectiveness of EPCS in eliminating prescription drug abuse.

2. DrFirst Software

Another system that can be used to monitor and reduce abuse of controlled substances in health care facilities is the DrFirst Software. This software has been designed to ensure that there is easy access to patient information. DrFirst improves the physician's clinical view concerning the patient during the time of care. It also ensures that there is a more effective collaboration with physicians and pharmacists in a health facility.

According to Sellars (2014) and Chen *et al.* (2013), some of the prescription given by qualified practitioners including physicians and nurses may lead to abuse of prescription drugs. When prescribing drugs, physicians always look at the patient's information concerning patients, a drug, and the direction to be followed by the patients. Sellars (2014) and Chen *et al.* (2013) claimed that it is not easy for a physician to manually track and follow up this information. These studies indicate that using DrFirst, the physicians can track the patient data and give an appropriate prescription to prevent abuse of drugs.

Porterfield, Engelbert, and Coustasse (2014), and Ayaz, Naqvi, and Branch (2015) argued that DrFirst is one of the E-prescribing systems which significantly help the physicians to understand the information of the patients before prescribing medication. According to these studies, the technology has some advanced features which enable the physician in charge of the prescription to access formulary information during the prescription process. It also allows the prescribers to electronically send the prescription to the pharmacy for documentation hence ensuring safety and quality prescription process.

3. Internet System for Tracking Over-Prescribing (I-STOP) - Prescription Monitoring Program

The internet system for tracking over-prescribing is another system used to monitor the drug prescription process to prevent abuse of prescription drugs. According to Brown *et al.* (2017), and Bahlani *et al.* (2015), the increase in morbidity and mortality in the US is associated with the abuse of prescription drugs. These studies indicate that the I-STOP law was implemented in the New York in 2013 to enable all the physicians to consult the statewide PDMP database to review the history of the patient before prescribing opioids.

Blum, Nelson, and Hoffman (2016), and Rasubala *et al.* (2016) argued that the PDMD is an effective tool in combatting the abuse, misuse, and diversion of prescription drugs. According to these authors, the use of I-STOP before prescribing controlled substances such as opioids can significantly help the physicians to know the information of the patient to prevent over prescription during the prescription process. According to Blum, Nelson, and Hoffman (2016),

and Rasubala *et al.* (2016), the I-STOP Act requires the physicians to consult the prescription monitoring registry before making any drug prescription or dispensing the drug to the patient especially when dealing with controlled substances such as Opioids.

According to Erickson (2016), the abuse of opioids by patients is an epidemic that affects several health facilities. However, this author argues that the only way to curb this crisis is to implement proper prescribing practices. According to Erickson (2016), the adoption of The Internet System for Tracking Over-Prescribing (I-STOP) Act has helped the physicians in New York to reduce the abuse of prescription drugs including opioids since it can enable the physicians to submit the prescriptions to the pharmacies electronically. According to Erickson (2016), the I-STOP Act was designed to reduce over prescription of opioids. This Act was also designed to punish the prescribers who fail to comply with the PDMPs.

4. The Kansas Tracking and Reporting of Controlled Substances system (K-TRACS)

Another system used in drug prescription is the Kansas Tracking and Reporting of Controlled Substances System (K-TRACS). This system is a website used to control the prescription drug monitoring in Kansas. Curry *et al.* (2015) claimed that the K-TRACS systems were designed to determine whether the physicians and the pharmacists in Kansas were using the PDMP in drug prescription. According to Curry *et al.* (2015), K-TRACS is important in the treatment of chronic pain while ensuring that there is no abuse of prescription drugs. This system also ensures that there is increased communication between the providers and the patients.

The above detailed systems are not the only ones in the market. Some organization did their own tracking systems as well as other governmental efforts invested into the technology to develop and implement tracking and monitoring systems to reduce the abuse epidemic of controlled substances. We only highlighted the most popular ones to represent the technology involvement in health care sector and particularly in fighting the controlled substance abuse epidemic globally.

2.6.2 Perceptions, Attitudes of clinicians towards prescription drug monitoring programs

Several benefits are associated with the use of prescription drug monitoring programs in health care facilities. Finklea, Sacco, and Bagalman (2014) claimed that the use of Prescription drug monitoring programs is of great benefit, especially in the prescription of drug abuse such as Opioids. According to these authors, medical use of controlled substances can be managed through the information that is collected by the Prescription drug monitoring programs.

Finklea *et al.* (2014) assumed that the prescription drug monitoring programs can be used in medical prescription to identify and prevent drug abuse and diversion. According to these authors, the prescription drug monitoring programs can also help the doctors to identify the prescription drug-addicted patients and come up with the appropriate intervention and treatment. According to their study, the prescription drug monitoring programs can also be used to enlighten people about prescription drug use, abuse, and diversion.

Gugelmann, Perrone, and Nelson (2012), and Leichtling *et al.* (2016) also discuss the benefits of using prescription drug monitoring programs in clinical decision making. In their study, these authors focus on reviewing the effectiveness of using the prescription drug monitoring programs and their potential challenges. These authors also discuss the history and funding of the prescription drug monitoring databases. They claim that more research needs to be conducted on the use and effectiveness of the prescription drug monitoring programs so that the clinicians can establish a safe and compassionate prescription on opioid stewardship.

Li *et al.* (2014) assumed that the abuse of prescription drugs, especially opioids has become a leading course of mortality and morbidity in the US. However, many states have implemented the use of Prescription drug monitoring programs to prevent the diversion and misuse of controlled substances (Li *et al.*, 2014). This study, therefore, focuses on evaluating the effectiveness of the prescription drug monitoring programs on drug prescription and overdose mortality. According to Li *et al.* (2014), the Prescription drug monitoring programs should be embraced by healthcare providers so that abuse of prescription drugs can be managed and prevented.

According to Qureshi, Al-Bedah, & Koenig, (2014), electronic prescribing has been adopted by major health organizations. However, there is a need for the primary care, outpatient settings, hospitals, and other private health sectors to implement the electronic prescribing systems to prevent abuse of prescription drug which causes mortality and morbidity among patients. Qureshi *et al.*, (2014) claim that HIS needs to be adopted across the Middle East countries to reduce prescription drug abuse.

According to Jariwala *et al.* (2013), physician views the pre-implementation strategy to unsubstantial. This affects the attitude and therefore the adoption of the program into their organisation. Many individual, health care professions not excluded, normally are not resistant to the implementation of the new work process in an organisation. Therefore better implementation process of an information system enables the physician to change their attitude and perception about the e-prescribing program.

The potential benefit of the program to the patient help encouraged the attitude and perception of the physician in the organisation. Physicians were enthusiastic about the possible outcomes of the program, which would affect the health care delivery and optimise the operation of their facilities. Greenwood-Ericksen, Poon, Nelson, Weiner, and Schuur (2016) claimed that in the past decade, managing care was more complicated because of the manual drug prescription which increased the rate of prescription drug abuse. However, according to these authors, managing care has become easier because of the HIS which has made drug prescription easier to prevent abuse, misuse, and diversion of the prescription drug.

According to Lander *et al.* (2014), having a deeper insight into the use of the HIS in a health care organization and its implications is important managing care in hospitals. These authors aimed to discuss the benefits of using prescription drug monitoring programs in the HIS to ensure that abuse of the prescription drug is minimized in care settings.

Lander *et al.* (2014) claimed that in the last two decades, mortality has increased in medical centers due to increased overdose of opioids. According to these authors, the prescriptions of opioids have rapidly increased leading to increased abuse, misuse, and diversion of this drug. According to this study, abuse of prescription drugs can effectively be managed using PDMP.

Norwood and Wright (2016), and Kirschner, Ginsburg, and Sulmasy (2014) claimed that integrating prescription drug monitoring programs in health care improves the ability of the clinicians to make informed clinical decisions when prescribing medication to the patients. According to these authors, integrating these programs can help in preventing prescription drug abuse and drug diversion. According to this study, further research should be conducted on the Prescription drug monitoring programs to understand the challenges that can hinder successful integration of Prescription drug monitoring programs in pharmacy practice.

According to McAllister *et al.* (2015), prescription drug abuse is a serious epidemic in healthcare organizations. Many organizations have adopted the use of PDMP to address

this problem. Through the Prescription drug monitoring programs, distribution of controlled therapeutic medication can be monitored and controlled. The drug prescribers and dispensers can also be assisted to make informed clinical decisions.

Worley (2014) claimed that abuse of prescription drugs is a serious health problem across the world. This author argued that doctor shopping is one of the most common ways that lead to prescription drug diversion and abuse as the patients visit numerous prescribers. Worley (2014) focused on reviewing the tactics that are used in doctor shopping and how the incidences of doctor shopping can be reduced in medical prescription.

Thomas *et al.* (2014) stated that the use of prescription drug monitoring programs has significantly helped in reducing abuse of prescription drugs. However, the main challenges that hinder the effective use of the Prescription drug monitoring programs include lack of consistency. This study indicates that for these programs to be effectively integrated into the prescription process there should be consistency in their use.

The physicians and pharmacists have different perceptions and opinions concerning the use of prescription drug monitoring programs. Hildebran *et al.* (2014), and Hagemeier *et al.* (2016) claimed that many physicians and pharmacists have recognized the significance of Prescription drug monitoring programs in identifying misuse, diversion, and excessive prescription of opioids in healthcare delivery. These authors claimed that even so, little is known about how the physicians and pharmacists intend to incorporate the Prescription drug monitoring programs into their workflow and clinical decision-making.

Hildebran *et al.* (2014), and Hagemeier *et al.* (2016) also claim that the clinicians continue to experience several barriers in sharing the prescription drug monitoring program results with their patients. These authors also posit that there is a variation between the routines for accessing the prescription drug monitoring programs data and the way physicians respond to it.

Fleming *et al.* (2014) claimed that many pharmacists exhibit fewer intentions of utilizing the prescription drug monitoring programs database because of the barriers associated with the system. According to these authors, the intention of the pharmacists to use this system in HIE can only be enhanced by using interventions that address the barriers encountered by the pharmacists. Fleming *et al.* (2014) also claimed that enhancing pharmacists' utilization of Prescription drug monitoring programs will reduce the mortality and morbidity rates associated with the abuse of opioids and other prescription drugs.

Increasing registration and use of Prescription drug monitoring programs remains important. According to Deyo *et al.* (2014), the feedback from clinicians and pharmacists indicates that using and responding to prescription drug monitoring programs' information would be facilitated through program enhancement and healthcare system changes. These authors claimed that the efficacy of the prescription drug monitoring programs can only be judged after best practices for their use are identified and assessed for their impacts.

According to Carnes, Wright, and Norwood (2016), some clinicians lack awareness of the system while most of the other clinicians claim that there are several constraints and barriers that hinder the access and use of the Prescription drug monitoring programs. However, some of the physicians and pharmacists who have used the Prescription drug monitoring programs agree that the system facilitates faster entry of pharmacy data and unique patient identifier.

Irvine *et al.* (2014) posited that some clinicians and pharmacists claim that the system is relatively new but offers effective tools that can enhance monitoring and prescription of controlled substances. However, according to Irvine *et al.* (2014), there is less information concerning the physicians and pharmacists who make the most use of Prescription drug

monitoring programs. These authors posited that according to the physicians' reports, most patients only request for help with drug dependence occasionally whereas other patients show denial and anger.

According to Irvine *et al.* (2014), more research needs to be done to assess how clinicians use the prescription drug monitoring programs and how they respond to the data. These authors claimed that if the use of prescription drug monitoring programs is understood, treating patients with pain while curbing prescription drug abuse will be made easier thereby reducing the abuse and diversion of opioids.

Physicians and pharmacists play a pivotal role in controlling or preventing prescription opioid abuse/misuse. The participation of pharmacists or physicians in the PDMPs is critical in reducing overall mortality and morbidity associated with prescription opioid abuse. In a recent survey among physicians on the awareness and utilization of PDMPs, 84% of the respondents were aware of the existence of PDMPs in their state, however, only 54% of respondents had reported to have utilized any of the services offered by the PDMP. The overall awareness and utilization of PDMPs was highly dependent on the medical specialty, wherein pediatric specialist would barely access or utilize PDMPs while emergency care physicians used such services or programs frequently. There is a need to target internal medicine and pediatric care physicians to utilize and benefit from PDMPs in their state (Feldman *et al.*, 2011).

It is critical to understand the attitude, knowledge, and preference of physicians in accessing or utilizing PDMPs, specifically with an aim to control prescription opioid abuse. Based on a recent survey comprising of 5,000 physicians, an estimated 71% of physicians agreed that PDMP was a useful, valid, and reliable tool in controlling opioid abuse. An estimated 72% of physicians agreed that PDMP would help decrease the rates of doctor shopping associated with prescription opioids. 98.4% of physicians agreed that

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the PDMP tool was a useful and critical component in assessing the patient's substance abuse or use history. Lastly, an estimated 64% have agreed that the PDMP tool has helped them decrease the levels of prescription for controlled substances (Gershman *et al.*, 2014).

The attitude, knowledge, and preference of physicians from various medical specialties are different in context in accessing or utilizing PDMPs. In a recent survey among 1,000 physicians from primary care, emergency medicine, and pain care, 74% of respondents reported that PDMPs were a useful and essential tool in medical practice. However, 20% of respondents reported to have difficulty in accessing PDMP information. In most cases, physicians indicated that the lack of knowledge on registration process was a key barrier to accessing or utilizing PDMPs. However, PDMPs helped physicians in decreasing their levels of prescription for controlled substances. Physicians who prescribed controlled substances to more than 50 patients in a week had a higher rate of PDMP utilization (Lin *et al.*, 2017).

Additionally, about the benefits of using the Prescription drug monitoring programs, Krischer, Ginsburg, and Sulmasy (2014), and Gugelmann and Perrone (2011) claimed that the use of Prescription drug monitoring programs has significantly reduced the mortality rates that are associated with inappropriate use and abuse of prescription drugs. According to these authors, the abuse of prescription drugs and particularly narcotic is one of the leading causes of deaths across the world. These authors claimed that prescribers should consistently use the prescription drug monitoring programs to prevent abuse of prescription drugs.

Some of the physicians and pharmacists have shown positive efforts in using the Prescription drug monitoring programs. According to Hagemeier, Murawski, Lopez, Alamian, and Pack (2014), and Barlas (2015), some community pharmacists have reported an increased use of Prescription drug monitoring programs in facilitating HIE

with the patients receiving the opioid prescription. These authors suggest further research needs to be conducted to identify and test the methods that can facilitate effective use of Prescription drug monitoring programs.

Studies indicate that the ability to use these Prescription drug monitoring programs is significantly affected by the lack of enough training and time. Wixson, Blumenschein, Goodin, Talbert, and Freeman (2015), and Lin *et al.* (2017) claimed that the use of prescription drug monitoring programs varies with the healthcare organization depending on the level of expertise of the physicians and pharmacists and technological advancement of the organization in question.

Lastly, according to these studies pharmacists and physicians from different organizations have different opinions and perceptions concerning the use of prescription drug monitoring programs in reducing prescription drug abuse. According to these authors, HIE is critical in reducing barriers that hinder access and utilization of prescription drug monitoring programs thereby increasing the effectiveness of the prescription drug monitoring programs.

2.6.3 Gaps identified in the current prescription drug monitoring systems

Although prescription drug monitoring programs significantly help in managing drug information in health care facilities, there are several gaps identified in such systems that hinder active drug information exchange. Schoenbaurn (2016) claimed that although the HIS plays a significant role in the promotion of care, gaps still exist because the prescription drug monitoring program is not always included in the HIE process.

According to this study, prescription drug monitoring programs are important in care delivery because they deal with the patient's history of prescribed and dispensed. Therefore, the programs should be included in HIE's cycle. According to Gillingham and Fredriksson (2015), HIE is important in managing care. This study indicates that despite the benefits of the HIE system; gaps still exist in proper use of this systems. Gillingham and Fredriksson (2015), in their study, analyzed the gaps in HIE and how information exchange can be improved in healthcare setting to reduce and prevent abuse of prescription drugs.

According to Griggs, Weiner, and Feldman (2015), the use of prescription drug monitoring programs is a major initiative that has been advocated by policy makers to help in reducing prescription drug abuse epidemic. This study focuses mainly on discussing the limitations that are associated with using prescription drug monitoring programs in eliminating the abuse of prescription drugs.

Weiner and Feldman (2015) claimed that there are some gaps in prescription drug monitoring programs that prevent active flow of HIE and unless they are addressed, the prescription drug monitoring programs cannot effectively work to reduce the abuse and diversion of the prescription drugs (Weiner & Feldman, 2015). This study focuses on reviewing the limitations that should be addressed.

Flanagan (2014) claims that effective coordination and support is required to overcome the challenges and gaps which do not allow effective flow of HIE's in care delivery. One of the challenges that are addressed in this study is the challenge of self-sufficiency in the PDMP. According to Flanagan (2014), self-sufficiency in Prescription drug monitoring programs is one of the most known challenges that affect the active flow of health information in care delivery.

Norwood and Wright (2016) argued that the only way through which prescription drug abuse can be dealt with is using effective HIE using prescription drug monitoring programs. According to Norwood and Wright (2016a), 94 percent of health facilities

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which have adopted the Prescription drug monitoring programs have managed to improve access to patient drug histories and reduce cases of prescription drug abuse.

These authors claim that there are barriers which have hindered the effective use of Prescription drug monitoring programs in the outpatient pharmacies. In such a way, to ensure that these programs work effectively in the outpatient pharmacies, the barriers should be identified and addressed as early as possible. This raises the need to come up with strategies and measures to curb such issues in the future.

According to Cames, Wright, and Norwood (2016), pharmacies cannot do alone in the prevention of opioid abuse. There must be a more cooperative relationship between the pharmacists and clinicians, integrated with a more advanced HIE to manage the epidemic of prescription drug abuse. These authors claim that funding is another issue that affects the effective use of Prescription drug monitoring programs in fighting prescription drug abuse.

Piper *et al.* (2016) claimed that although pharmacists are aware of the prescription drug abuse especially the abuse of opioids, many of them do not use the Prescription drug monitoring programs consistently and as a result, it has become difficult for them to deal with the problem of prescription drug abuse. According to Piper *et al.* (2016), the abuse of opioids in care delivery continues to be a major issue that leads to morbidity and mortality in hospitals. Piper *et al.* (2016) also, claims that to minimize these gaps, there should be consistency in the use of the Prescription drug monitoring programs in HIE in medical centers.

According to Smith *et al.* (2015), Prescription drug monitoring programs are important in health facilities because they enable the pharmacists to identify opioid/controlled substances misuse among patients and enhance provider-patient communication. The use of the Prescription drug monitoring programs in practice, however, varies among the

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physicians and pharmacists. Smith *et al.* (2015) discussed steps that can be used to manage the barriers that are associated with Prescription drug monitoring programs.

The following points are a list of the summarized gaps, identified in literature reviews, that need to be considered and corrected in the proposed enhanced IS processes model.

- 1. No integration with the organization's HIS hindering prompt information exchange and accurate decision-making process
- 2. No integration cycle with the rest of the health care facilities
- Not friendly used and functionalities issues in prescription drug monitoring system
- 4. System limitations, that need to be enhanced to allow active information flow
- 5. Lack of self-sufficiency in the PDMP, that affect the active flow of health information in care delivery
- 6. Poor communication relationship between ordering physician and pharmacist
- Funding is another issue that affects the effective use of Prescription drug monitoring programs in fighting prescription drug abuse
- Missing consistency in the use of the Prescription drug monitoring systems in HIE resulting in a poor reliability
- 9. Variation in practical use of prescription drug monitoring system among care providers

2.7 Summary

The chapter focused on introducing and presenting the controlled substance abuse and misuse issue as a global issue and a concern for all countries including Saudi Arabia.

Multiple literature reviews were performed to cover the progress of HIS revolution including electronic prescription system that must be integrated with the HIS to have a powerful tool when providing patient care. Literature review had also identified unlimited benefits of digitalizing patient care services to ease the job of user and provide a safe environment for patients. Multiple literature reviews done on the integration of different HISs in different organizations and its importance to perform a possible interoperability and grant a smooth, prompt patient information flow both sides. This also supported by a review of the HIPAA privacy and security guidelines in addition to the Saudi Arabian policies that governs patient information exchange among different care providers.

A big portion of the chapter focuses on the current prescription drug monitoring systems in use in most of the United States as well as other countries like France and Australia. It also analyzed most of the benefits gained from using besides some criticism of its performance and limitations. This chapter concludes by identifying all reported gaps of the current systems. These gaps vary from missing integration with HIS, funding, and lack of sustainability to functionalities limitation. The next will be chapter three which will be covering the methodology applied in this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Research is conducted in a frame with a research philosophy, viewed from a specific perspective and constructed through specific procedures. The perspectives and techniques of research are referred to as research methodology. This chapter aims to provide the philosophy and framework that guides the collection of data, its analysis and interpretation of the findings, in a way that fits the research objective and answers the research question. The chapter also provides orientation that influences the findings of any research within any field. The main objective of this chapter is to discuss the methodology that will be applied to the proposed study. The aim is threefold, to discuss the philosophical assumptions underpinning the study, provide a rationale for the method selected and discuss the strategies that will be used.

Section 3.2 presents research design. Context of the study is presented in Section 3.3. Sampling and recruitment are presented in Section 3.4. Section 3.5 presents Data collection procedure while Data Analysis is presented in Section 3.6. Trustworthiness of the Study and Ethical Considerations are presented in Section 3.7 and Section 3.8. Finally, Section 3.9 summarizes the chapter.

3.2 Research Design

The current study is situated within the interpretivist philosophy. The proposed study seeks to comprehend the experiences of pharmacists and physicians in using HIS to track opioids and controlled substance abuse patients in Saudi Arabia. Such experiences cannot be quantified. Thus, it is difficult to employ a positivist approach. Secondly, experiences

are constructed within a social context that is inseparable from those who experience the phenomenon. Trying to understand the experiences using an objective view separate from the subject would be futile. One must immerse him or herself into the world of physicians and pharmacists by listening to their narration and accounts of their experiences. An indepth understanding is required to immerse into the world of the physicians and pharmacists, capture their unique experiences to understand the way of interaction with information systems when prescribing opioids or other controlled substance.

The current study employs a qualitative as well as quantitative approach as it provides an in-depth understanding of the ways people come to understand, act, and manage their day-to-day situations in particular settings at the same time the study uses SPSS for statistical analysis. Many scholars contend that social phenomenon is best studied using qualitative approaches. The proposed study is about the experiences of pharmacists and doctors in using healthcare information systems to manage opioid and controlled substances prescriptions. Such experiences are a function of the context of where they are created, individual perception of the event and personal interaction with the phenomenon (patients, opioids, and HIS). The portrayal of the processes that characterize such experiences rely on the narratives of human actors. Qualitative approaches record the narratives of those who experience the phenomenon with the purpose of creating knowledge. It is, therefore, well suited for the proposed study. Furthermore, qualitative approaches are epidemiologically underpinned by Interpretivism and constructivism ontologically –and therefore align with the assumptions of the researcher on creation of knowledge and the nature of reality.

The current study adopts an interpretative phenomenological analysis (IPA) strategy, as it aligns with the philosophy of the study and the aim of the study. It aims to explore the detail process of making sense of personal and social world, and the main currency for an IPA study is the experiences, events, states hold for participants. In interpretative phenomenological analysis, the research seeks to comprehend social and personal world by examining the personal experiences in detail (Denzin & Lincoln, 2000). The researcher seeks to comprehend the experiences by immersing themselves within the context of the experience to gain an insider perspective. IPA is concerned with the experiences of the respondents, what such experiences are like and the perspective of the informant about the experience. Immersion into the world of the subject can lead to in-depth and detailed comprehension of the phenomenon. Enhancement of the workflow of the research and validation also will be conducted in the study.

3.3 Context of the Study

A context comprises of the conditions, environment, and culture of the participants and location. The participants in the research are pharmacists and physicians who work in hospitals in the Kingdom of Saudi Arabia. The specific setting of the study are two hospitals that have adopted electronic HISs a long time ago and have a high number of patient visits. One of the selected hospitals is a tertiary care center called King Faisal specialist hospital and research center, the other one is a Drug Addiction & psychiatric hospital called AL AMAL Hospital. All two hospitals located in Riyadh city, the capital of Saudi Arabia, where most of the population resides. More elaboration on the study sites and participants working environments will be presented in chapter four.

3.4 Sampling and Recruitment

The current study will employ a mixture of purposive, convenience, and snowballing sampling. Convenience and snowballing sampling will be used to identify potential subjects, after which a potential representative sample will be selected from the selected individuals, the key reason for such an approach is because the researcher does not have access to the two facilities, and it would be difficult to identify potential participants without direction from either the administrators or individuals working at the facility. By combining the three sampling methods, the researcher will be able to overcome the limitations of each sampling method. The sampling methods involve primary data source nominating other potential data sources that will be able to participate in the research studies. Snowball sampling method is purely based on referrals and that is how a researcher can generate a sample. Therefore, this method is also called the chain-referral sampling method.

During the sampling process, the researcher will identify individuals who might be knowledgeable about prescriptions of opioids/controlled substances in the facilities either through personal contacts or through the administration of each facility. The researcher will then compile a list of potential subjects and try to determine the individuals who are likely to provide the richest information. This will be based on prior information about the individual or information provided by the administration that such an individual has prescribed opioids in the past. Physicians will be requested to nominate potential interviewees who will then be screened to determine their suitability. Pharmacists and physicians who have used HSI to prescribe opioids/controlled substances, have been in contact with opioids/controlled substances users and have been working in any of the facility for more than one year, will be allowed to participate. Those pharmacists and physicians who do not use the HIS system, have worked for less than one year in any of the given facility will be excluded. Each potential candidate will be contacted individually through either telephone call, email, or letter and requested to participate in the research. The aim is to select at least 10 physicians and 10 pharmacists from each facility. The below table shows the number of the participants and their profiles from both facilities.

Table 3.1: Number of Interviews Conducted and Participants' Codes and Profiles

Hospital	Participant	Gender	Position	Nationality	Working area	Interview location	Interview date and time	
	MD-01	М	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	8 Feb, 18	1500
1. King Faisal Specialist	MD-02	М	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	12 Feb,18	1500
Hospital & Research	MD-03	М	ER physician	SA	Emergency Dept. / KFSHRC	Doctor Meeting room	22 Feb,18	1500
Center	MD-04	М	ER physician	SA	Emergency Dept. / KFSHRC	Doctor Meeting room	26 Feb, 18	1500
	MD-05	М	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	28-Feb,18	1800
2. Al-Amal psychiatry	MD-06	М	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	29-Feb,18	1600
hospital.	MD-07	М	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	30-Feb,18	1300
	MD-08	F	ER physician	SA	Emergency Dept. / KFSHRC	Doctor Meeting room	5-Mar,18	1400
Both hospitals are located	MD-09	M	ER physician	N-SA	Emergency Dept. / KFSHRC	Doctor Meeting room	8-Mar,18	1800
in Riyadh City.	MD-10	М	ER physician	SA	Emergency Dept. / KFSHRC	Doctor Meeting room	10-Mar,18	1400
	MD-11	М	ER physician	SA	Emergency Dept. / RMC	Doctor office	12-Mar,18	1500
	MD-12	М	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	13-Mar,18	1500
	MD-13	М	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	15-Mar,18	1500
	MD-14	М	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	17-Mar,18	1700
	MD-15	М	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	18-Mar,18	1600
	MD-16	М	ER physician	SA	Emergency Dept. / RMC	Doctor office	23-Mar,18	2000
	MD-17	M	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	9-April,18	1600
	MD-18	М	ER physician	N-SA	Emergency Dept. / RMC	Doctor office	12-Apr,18	2300
	MD-19	М	ER physician	N-SA	Emergency Dept. / RMC	ER working station	4 May,18	1100
	MD-20	М	ER physician	N-SA	Emergency Dept. / RMC	ER working station	5 May.18	900
	PH-01	M	Pharmacist	SA	KACOLD Pharmacy	Meeting room	4 Feb, 18	7:00
	PH-02	F	Pharmacist	SA	ambulatory pharmacies	Admin. Office	6 Feb, 18	8:00
	PH-03	F	Pharmacist	SA	NT Pharmacy	Admin. Office	6-Feb-18	9:00
	PH-04	F	Pharmacist	SA	Main PHARMACY	Admin. Office	8-Feb-18	12:00
	PH-05	М	Pharmacist	SA	Infusion pharmacy	infusion pharmacy	11 Feb,18	13:00
	PH-06	F	Pharmacist	SA	MAIN OP PHARMACY	OPD building	12-Feb-18	9:00
	PH-07	F	Pharmacist	N-SA	Emergency pharmacy	ER Pharmacy	27-Mar,18	17:00
	PH-08	М	Pharmacist	SA	Emergency pharmacy	ER Pharmacy	29-Mar.18	14:00
	PH-09	F	Pharmacist	N-SA	Emergency pharmacy	ER Pharmacy	29-Mar,18	15:00
	PH-10	М	Pharmacist	N-SA	Emergency pharmacy	ER Pharmacy	1-Mar,18	16:00
	PH-11	F	Pharmacist	SA	RMC/ Drug safety	Pharmacy Admin	7-Mar-18	12:00
	PH-12	М	Pharmacist	SA	RMC/ Clinical pharmacy	Pharmacy Admin	9-Mar-18	10:00
	PH-13	F	Pharmacist	SA	RMC/ Clinical pharmacy	Pharmacy Admin	10-Mar,18	0:00
	PH-14	М	Pharmacist	SA	RMC/ Main pharmacy	Pharmacy Admin	11-Mar-18	1400
	PH-15	М	Pharmacist	SA	RMC/ Main pharmacy	Manager. office	19-Mar,18	1400
	PH-16	F	Pharmacist	SA	RMC/ Outpatient pharmacy	Manager. office	20-Mar,18	1400
	PH-17	F	Pharmacist	SA	RMC / Outpatient pharmacy	Manager. office	20-Mar,18	1500
	PH-18	F	Pharmacist	SA	RMC/Outpatient pharmacy	outpatient offices	27-Mar,18	1300
	PH-19	F	Pharmacist	SA	RMC/Emergency pharmacy	ER Pharmacy	13-Apr,18	1800
	DH.20	M	Dharmacist	NI SA	RMC/Emergency pharmacy	FR Dharmacu	14-Apr 18	2300

3.5 Data Collection

The current study seeks to review the current practices in both sites on how they are using HIS to curb abuse issues as well as understand attitudes and experiences of physicians and pharmacists when using HIS to prescribe opioids or any other controlled substances. Thus, the most appropriate data collection tool is the one that can capture their narrations in an in-depth manner. While it is vital to use methods such as observations, personal accounts and diaries, the most appropriate data collection method for the study is in-depth interviews. In-depth interviews can be divided into three, structured, unstructured, and semi-structured, each warrants discussion (Brinkman, 2014). Unstructured interviews are less common. The researcher does not set the question in advance and just interview the

respondent based on the general aim of the research. Unfortunately, unstructured interviews are susceptible to collection of huge information that may deviate from the subject matter. As such, use of unstructured interviews would be cumbersome for the researcher and may fail to collect the right information (Edwards & Holland, 2013; Alshenqeeti, 2014).

The questions are open ended. First, the researcher establishes rapport, then starts to ask the questions. The interviewer is free to probe the respondent to ensure data saturation. Flexibility associated with semi-structured interviews allow the discussion to evolve and develop in interesting ways allowing the respondent to expand their answers (Kvale & Brinkmann, 2009; Gubrium & Holstein, 2002). When using structured interviews, the researcher first determines the data that will be collected prior to conduct the interview. Questions that are used during the interview process are designed to reduce any variations during the interviews. In structured interviews, the interview uses short specific questions with pre-coded response categories that enable the interviewer to match responses to those categories (Wilson, 2016). In addition, questions are asked in the same sequence with each interview. Structured interviews are like questionnaires as the interviewer is simply going through the written questions and recording specific responses. Although, this limits the amount of information that can be collected, interviewees are encouraged to elaborate in depth through prolonged discussion relevant to the questions. Thus, the semi structured interview is the best for the current research, as the aim of the study is to collect rich information (Bryman, 2015).

3.5.1 **Pre-interview Questionnaire**

There are several factors that will consider during the development of the questionnaire. First, the questionnaire should be short but sufficient to gauge knowledge of the informant on the topic. People have short attention span, which means that if the questionnaire is long, the respondent will rush to finish which increases the likelihood of wrong responses. Furthermore, respondents tend to skim through the questionnaire rather than reading and understanding the questions. The second consideration is the sequencing of the question. Questions that fall under a common them will be grouped together to enhance the effectiveness and usability of the questionnaire (Bryman, 2015). Questionnaire is represented by four themes to evaluate the informant's perception on the issues of abuse/misuse, their orientation to HISs and its integration as well as the information exchange process with other health care facilities.

A group of experts of 6 members were formed for analyzing, correcting, and validating the questionnaire. Among the six members four of them were professors from the Faculty of Computer Science and Information Technology, Universiti Malaya (UM), and two were medical staffs from UM clinic and health care center. After preparing the questionnaire individual feedback were accumulated and the suggestion are incorporated. After that the final questionnaires were approved and validated through couple of group meetings.

3.5.2 Interview Process

A list of open-ended questions relating to the aim of the research were constructed based on the existing literatures on the issue and particularly literatures that are pointing to a raising abuse/misuse issue uniquely in Saudi Arabia. A pilot interview was conducted prior to the actual research to determine the suitability of the research interview questions in capturing the right data for answering the research questions. The pilot study involved individuals in similar position and similar education background. Issues identified at the pilot stage were ironed out prior to the actual interviews. In addition, the researcher seeks the inputs of other scholars and experts on the suitability of the final list of the interview questions. Using a predetermined schedule (Appendix A), the interviewer prepared for the encounter and set the agenda of the interviewee. The first stage of the interview process will be opening of the interview (Ryan & Dundon, 2008). Sometimes the interviewees are uncertain of their roles and can be suspicious. At this stage, the role of the interviewer will be to introduce the research in depth, including the purpose and aim if such information has not been explicitly discussed with the interviewee. Since interviewees can be suspicious of the motives of the researcher, it was essential for the researcher to get to know each other by introducing self. Stage II of the interview process involved searching for a common ground or building rapport. Building rapport is important as it determines the quality of the relationship between the interviewee and the researcher, as well as the quality of the data elicited. This is because an individual is likely to provide richer stories and in-depth explanations when they are trusting and comfortable. Rapport was maintained throughout the interview (Goudy & Potter, 1975; Dundon & Ryan, 2009). All interviews will be recorded with informant's permission and transcribed at later stages, rather than taking points to reduce distractions and errors. Each interview was expected to take 30 to 45 minutes.

3.5.3 Observation

In the progress of this research, it became critical to derive data through a participatory study. Like the usage of case studies in research, observation, also, enables a researcher to immerse themselves in a setting through observing and taking notes or even recording. In this study, it should be observed that HIS is essentially developed to enhance healthcare delivery and access. As such, seeking to enhance HIS involves investigating how respondents are interacting within the available system. In this regard, within the confines of this study, an observation of the participants using the HIS was conducted during the conduct of their meeting with patients. Following this, their use of the HIS created a platform on which observation could be adopted as an extra rich data collection tool.

Among the various methods of data analysis, most of them are complex and cumbersome to the novice researcher. To ensure credibility without burdening the researcher, the proposed study will employ two ways of analysis. The first part will be SPSS analysis for the interview questionnaire conducted prior to the interviews, and the second is a stepby-step data analysis process, described by Burgess-Allen and Owen-Smith (2010), particularly for the interview parts. The process is illustrated below:

Stage 1: Exact Transcription of individual interviews.

Stage 2:Reading and re-reading to assist in the immersion into the data,Reading andactive engagement for a richer comprehension of the data. Searchre-readingfor paradoxes and contradictions. Spot shifts in patterns and
accounts.

Stage 3:Analyze the language and the semantics of the content. IdentifyAnalyze theparticipants' perspective on an issue. Note down context andlanguagelanguage used. Add descriptive (what did the interviewee say),linguistic (interviewee language use), and conceptual comments(interpretive comments) to the text. Select the text that seemsimportant.

Stage 4:Based on the comments noted in step 3, reduce the amount of dataIdentifyingby mapping patterns, connections, and interrelationships. Createemergentchunk themes that are grounded in the data.

themes

Stage 5:Map themes that appear to be interrelated and use the researchIdentifyingquestion to determine how well they fit. Group the themes together.connectionsEmploy abstraction (developing superordinate themes),across thesubsumption, polarization, and contextualization, as well asthemesnumeration to map the themes and represent them graphically.

- Stage 6:Move to another case and try to bracket the knowledge or
assumptions viewed in the previous interviews
- Stage 7: Identifying connections in themes across and between interviews, identify shared meaning, and ensure most focus is put on interpretation.
- Stage 8: Seek peer review

This study is going to use SPSS software and thematic analysis as the tools for analyzing the collected data. SPSS will be used to do the pre-interview questionnaire analysis while thematic analysis will handle the interview findings.

3.6.1 SPSS Software

SPSS is a type of software that is used for batched or interactive statistical analysis. In this case, the SPSS is used to analyze the pre-interview questionnaire to come up with the required results. It has got many features that can be accessed by using the drop-down menus (Unicom, 2015). The features also can be programmed by using the command syntax language which is a proprietary 4GL. The SPSS statistics software also allows some of the complex applications to be programmed by using the available syntax. Such complex programs are usually not reachable by using the menu interface. The pull-down menu on the face of SPSS produces the command syntax, which is shown in the output, but the default settings must be altered for the user to be able to see the syntax. This can be pasted in the syntax file using the paste button that is available in every menu. Also, SPSS allows programs to be run unattended or interactively using the supplied Production Job Facility (Unicom, 2015). The command syntax programming that is provided for in SPSS simplifies tasks that are repetitive, handles complex data analyses and manipulations, and eventually reproduces the output. SPSS takes data from different types of files, and uses it to generate charts, trends, and plots of distribution, tabulated reports, and descriptive analysis. The software is also used in conducting statistical analyses that are very complex (Divya, 2017). The SPSS program can be used anywhere at any time as it is available for both the mainframe and personal computers. SPSS is beneficial to both quantitative and qualitative data and gives equal importance to both the data sets (Divya, 2017). SPSS is also user-friendly as the beginners find it easy to use compared to other software available in the market. SPSS allows a process that entails drag and drop operations which contain few advanced statistical analyses and almost all basic analyses that help the researchers to adapt easily to the software (Divya, 2017). With the simple steps, the software does the analysis part perfectly well to produce the required results. SPSS helps to give the desired analysis even when the data set grows to huge volumes. It usually provides a graphical representation of the perfectly and appropriately prepared result for the data entered.

3.7 Trustworthiness of the Study

The research procedure outlined above requires consideration of how the researcher will ensure that the findings obtained through the process are valid. Much of the discussion on validity and reliability is focused on quantitative designs or studies supported by the positivist paradigm (Golafshani, 2003). Indeed, the definition of both concepts is rooted in the positivist paradigm. Most researchers find that the subjective nature of qualitative research makes it difficult to maintain reliability and validity, when defined from a positive perspective. Instead of focusing on validity and reliability, terms that do not fit the philosophy of qualitative research, the focus should be on research reliability (Sandelowski, 1993; Rofle, 2006). The first step to increasing the reliability of research is to use audible methods. If researchers use widely accepted and known methods to provide factual and credible data on a topic, the findings and processes can be regarded as credible (Gunawan, 2015). Therefore, most studies on a phenomenon tend to use a method like previous studies on a particular subject, except that the previous method is considered unsatisfactory. As discussed, each element of the research procedure can be audited and supported by available scientific evidence. This enables an individual to study the methodology and determine whether the findings of the study are reliable or not.

In the current study, peer review will be used to increase credibility at three key levels, design levels, where researchers will allow peers to research methods and determine whether they can collect data that can answer researchers' questions, pilot levels, where peers will be allowed to review the interview questions and determine their suitability, and the final stage of the data analysis. At the data analysis stage, the research will involve three other researchers who will independently interpret the data and compare the findings. In the current study, interview and pre-interview data collection methods were selected to be used for data collection. Instead of introducing new methods of data collection, researchers will use triangulation through data sources. This involves the use of various information (Guba & Lincoln, 1989). Here, the narratives or explanations that are interviewed are validated against each other, ultimately providing a rich picture of the subject matter of the study. This study will also use data from organizational management to reinforce the story. In addition to data-based triangulation, the proposed study will use site triangulation. This involves selecting different organizations to reduce the influence of local factors on findings (Shenton, 2004; Gunawan, 2015). Therefore, two facilities were selected. Other methods used to improve the reliability of the study are shown below:

Table 3.2: Methods to Ensure Trustworthiness of the Study

Quality criterion	Steps taken by researcher		
Credibility	Adopt accepted research methods and procedures		
	Familiarize oneself with the organizations		
	Triangulate data		
	Strive to ensure that the participants are honest		
	Frequent debriefing of the researcher and the superiors		
	Use reflection		
	Capture a thick description of the phenomenon		
	Allow peer scrutiny		
	Provide a clear description of the researcher, their qualifications and experience		
Transferability	Discuss in detail the context of the study to allow other scholars to make comparisons		
Dependability	Provide a clear discussion of methods used in a such a way that the research can be repeated		
Confirmability	Triangulate data		
	Discuss researcher's assumptions and beliefs		
	Provide a clear description of procedure and results to allow other scholars to audit them.		

3.8 Ethical Considerations

Qualitative research requires researchers to interact deeply with participants while collecting data. Orb, Eisenhauer, and Wynaden (2001) reminded researchers that such a form of data collection involves invasion of participants' privacy. This can cause ethical issues if the researcher fails to consider the individual rights of the participants. As noted by Creswell (2003), participants have rights, values and should always be respected. Some issues to consider as discussed by Miles and Huberman (1994) include: informed consent, danger and risk, honesty, and trust, anonymous, confidentiality and privacy, advocacy, and interaction. In compliance with the ethical guidelines adopted in conducting research, these issues will be considered. The following steps will be taken before, during and after the survey to ensure the rights of informants are protected.

3.8.1 Informed consent

Prior to the actual interviews, the researcher will inform potential interviewees the purpose of the study, including the scope and objective of the study. In addition, the researcher will explain the methods that will be employed and the roles of the researcher and the informant. The informants will sign an informed consent form (Appendix B) after understanding their roles and what the research is about. The consent form is attached to the survey questionnaire and interview questions and must be signed by each participant and dated by the interview date. Consent is stored at the top of each interview document for reference.

3.8.2 Risk and harm

Prior to the study, the organization research committee will review the project proposal and determine its suitability and whether it poses any risks to the informants. If any risk is identified, the project will be amended to ensure that no participants will be put in harm's way, either psychologically, physically, or emotionally. All procedures will be reviewed in this study to ensure that all guidelines regarding participants protection are followed.

3.8.3 Anonymity, confidentiality, and privacy

All identifying data that may breach the anonymity, confidentiality, and privacy of the participants will be removed. A code will be assigned to each informant to protect their identity. In addition, the researcher will seek a confidentiality letter to prevent third parties from subpoending the researcher. During dissemination, no identifying information will be used (Aita & Richer, 2005).

3.8.4 Voluntary participation

Although the informants will be required to sign a consent form as an indicator that they have understood the aim of the researcher and the procedure. There are other precautions that will be taken to protect the participants. No informants will be forced to contribute to this study. Further, the informants will have the right to withdraw from participating without any repercussions or consequences. No compensation or benefits will be provided to ensure that no single informant is pressured to participate (Creswell, 2003).

3.9 Summary

It is essential to mention that the current research is situated within the interpretive philosophy for several reasons. It seeks to understand the experiences of pharmacists and physicians in using HIS to monitor opioids and controlled substance prescriptions in Saudi Arabia. While quantitative and qualitative approaches are not superior to each other, the current study will employ a qualitative approach. The study is about the experiences of pharmacists and doctors in using healthcare information systems to manage opioid and controlled substances prescriptions. Such experiences are a function of the setting of where they are created, the individual opinion of the event and personal interaction with the phenomenon. It is, therefore, well suited for the proposed study. The strategy aligns with the philosophy of the research and the aim of the study. During the sampling process, the researcher will identify individuals who might be well-informed about prescriptions of opioids/controlled substances in the facilities either through personal contacts or the administration of each facility. The researcher will then accumulate a list of potential subjects and try to determine the individuals who are likely to provide the most productive information. Physicians will be requested to propose potential interviewees who will then be screened to determine their suitability. The aim is to select at least 10 physicians and 10 pharmacists from each facility with a total of 40 participants.

The current study seeks to understand the attitudes and experiences of physicians and pharmacists when using HIS to prescribe opioids or any other controlled substances. As a result, the most accurate data collection tools are tools that capture their narrative in depth. While it is possible to use methods such as observations, personal accounts, and diaries, the most appropriate data collection method for the study is in-depth interviews. To ensure credibility without burdening the researcher, the proposed study will employ two ways of analysis. The first part will be SPSS analysis for the interview questionnaire conducted before the interviews, and the second is a step-by-step data analysis process described by Burgess-Allen and Owen-Smith (2010) mainly for the interview parts. The SPSS will be used to conduct the questionnaire analysis before the interview while the thematic analysis will be conducted for the interview findings.

CHAPTER 4: CASE STUDY OF THE RESEARCH

4.1 Introduction

Case study research is the commonly used qualitative method for studying information systems (Alavi & Carlson, 1992). In this study, two specialized hospitals located in Riyadh City were selected as the research case studies to address the research questions, understand the current practices of the organization's HIS, as well as obtaining some perceptions of the system users (physicians and pharmacists) in curbing the Opioid abuse issues.

In this chapter, we begin with the introduction of the case study as the research design as well as observation process technique conducted in both sites. Both hospitals use the HIS to manage and provide patient care including the management of Opioid abuse patients attending the hospital. More information on these two facilities will be presented in this chapter to understand the level of patient care management and technological capabilities that have led researchers to use it as a case study.

4.2 Case Study as the Research Design

In this qualitative research, we are adopting case study as the research design. For data collection, researcher used interviews and observations as instruments, in addition to pre-interview questionnaires at the beginning of the study and data collection process.

The use of different techniques to collect data is important to assure the ethical needs of the study in term of validity and reliability of the process (Berg, 2007).

In a review, Schmidt, Rotgans, and Yew (2011) observed that in the constructive nature of learning, situational interest is very importance. Ideally, the learning process has been
observed to involve relative comparisons in the presentation of complex concepts. Eventually, this results in the establishment of either practical or theoretical modes of learning. Application of any theory or principle can be a learning exercise. This learning can be during the application, which can help to continuously improve the application of theory or principles to optimize any process, system, or organization. This learning can also be after the application of theories or principles.

When learning is done on a process, project, or event which has already happened, then its performance or output cannot be changed, but the learning can help in future applications. In their exploration of the integration of theoretical and practical learning processes, Wrenn and Wrenn (2009) observed that while it is essential to gather knowledge of the working processes, it is essential to experience the application of said principles in a practical setting. In research, one seeks to determine the underlying factors behind the effectiveness, failure, or other parameters in the process of a social, technological, or even economic phenomenon. However, in all these cases, it is sufficient to note the need for practitioners of each practice. As such, exploring the relative nature of a field calls for the research to integrate both theoretical and practical paradigms to enhance their learning process (Wrenn & Wrenn, 2009).

Particularly, the case study approach is sought when there are needs for an in-depth appreciation of an interest. Mainly, this is as observed in the actual natural and real-life context. As Crowe and colleagues note (2011), through the development of these case studies, it becomes possible to establish a research design with extensive coverage, especially of a social phenomenon. Eventually, this facilitates the expansion of a body of knowledge, thus facilitating the learning process. Additionally, Goodrick (2014) noted that to achieve better generalization, it is essential to run comparative cases. Through such a strategy, the researcher manages to draw an elaborate analysis of the patterns,

similarities, and differences between different cases. Consequently, these are vital tools whose utility in the learning process is indispensable.

In a review of the use of case studies as a scientific method, Krusenvik (2016) observed that while there are schools of thought that consider it mere storytelling, most scientists hold it in high regard. Mainly, this can be deduced from the fact that cases studies allow for one to intensively explore an event with few units but a myriad of variables. Gorard's (2010) sentiments agree with this in the sense that a research design is primarily aimed at maximizing the generation of evidence with a given level of resources. Fundamentally, this allows for experiential growth of the body of knowledge.

In their exploration of reinforcement learning, Mnih *et al.* (2016) noted that the interaction of a learning agent within a learning environment ends in the output of different results. Through this, subsequent processes on a similar plane are evaluated relative to the previously observed results, thus enhancing the determination of the new output. In this regard, the concept of success and failure in an event gains acceptance as an integral element of the entire research paradigm. To learn from success or failures of any process or projects, those events are documented accurately as a case to find out causes of the output. If the output is a failure, then researcher may try to find the reasons for failure, and if the output is a success, then the researcher may better understand how and when to apply theories or principles. If there are any anomalies in output, they can also be identified (Ridder, 2017).

The documented events or actions leading to outputs are termed as a case, and its goal is to enable case study and thereby learning. The use of a case study as a research method is recommended when the thesis being tested has to do with the application of theories or principles (Mills *et al.*, 2010). Case studies can help the researcher find out how to best use theories or principle, get knowledge of loopholes and observe the need for the theory

or principles in a real environment. There is also a method to a case study where theory does not exist first but is inferred from the case (Eisenhardt, 1991). Barratt, Choi, and Li (2011) highlight the importance of clarity in theory building. Fundamentally, the use of case studies allows a researcher to expound on a concept through tests. In this manner, deductive or inductive conclusions can be derived from a case thus enhancing the research process.

Case studies can be used in qualitative studies to validate a hypothesis about any theory or principles. Case studies can be used to infer and propose any new theory. It benefits include real learning which has been validated to work or not to work in the real world. Case studies can also help the researcher realize situations or scenarios to exist, which the researcher may have not comprehended without its help. As Crowe and her colleagues (2011), through case studies, a researcher can offer a description of an event relative to daily occurrences. As such, an individual gathers the factors precipitating causality and pathways rooted in different phenomena. Subsequently, this serves to endear the use of case studies among researcher as highlighted by Gustaffson (2017). However, in each research method, one must determine the true definition since qualitative results can be achieved through single or multiple case studies. Ultimately, this makes it possible to perform comparative analysis and thus enable the theory development process.

4.3 Observation as a Research Instrument

In the progress of this research, it became critical to deriver data through a participatory study. Like the usage of case studies in research, observation, also, enables a researcher to immerse themselves in a setting through observing and taking notes or even recording. In this study, it is observed that HISs are essentially developed to enhance healthcare delivery and access. As such, seeking to enhance HIS involves investigating how respondents are interacting within the available system. In this regard, within the confines of this study, an observation of the participants using the HIS was conducted during the conduct of their meeting with patients. Following this, their use of the HIS created a platform on which observation could be adopted as a research method.

Ritchie and colleagues (2013) made notes of the fact that in academia, there is no single accepted method across all discipline for qualitative research. Cognizant of this, it suffices to note that the fundamental result expected of a data collection process is the gathering on inputs that affect the phenomenon under study. Within a social experiment, as is the case in this study, data gathering involves immersion of the researcher in the very setting in which the respondents are. In Savin-Baden and Howell-Major's (2013) work, it becomes clear that in a research project, data collection involves a plethora of approaches.

While observation can be structured on unstructured, direct access to the data source is assured. In the field of information technology, one of the factors that should be considered is the human element during the interaction between an individual and the system (Creswell & Poth, 2017). Despite the extent to which simulations can be conducted to determine the viability of a system, without direct human interaction, it is considerably difficult to define the human experience devoid of interaction with an individual. In this regard, structured observation facilitates the use of specific variables in a pre-defined manner. In this case, the procedure of data acquisition, entry, and subsequent search would be adopted in making observations on the use of HIS in the study. However, it is also essential to note that carrying observations in a free manner devoid of any pre-determined variable is still a viable means of data collection. In this case, the random nature of the process allows for reduced bias. Ideally, the data collected would be fashioned such that drawing of conclusions would be predicated by the flexibility of the entire health care process (Creswell & Poth, 2017). Ideally, this allows

for coverage of variables that would be missed in the formulation of an observation structure.

Additionally, in experiential learning, observations facilitate reflection. Basically, this is rooted in the fact that watching activity behavior enables one to potentially gain knowledge of the utility of the system (Kolb, 2014). In the conduct of the research, first-hand knowledge of the effectiveness of the system must be acquired. Though it is possible to draw such data from the actual users, interacting with the subjects in their daily routine allows for the study to gain knowledge directly. While observation does not involve direct interaction with the system, seeing the participants and the patients interact creates a platform on which experiential knowledge is gained.

4.4 Case Study Sites

Ministry of health in Saudi Arabia is the only agency that legitimize and provide guidelines to control the distribution, prescription, dispensing, storing, and disposing of controlled substance including Opioids. These guidelines had specified the role of every clinical provider in term of how to manage the ordering of the controlled prescription and dispensing the same drug (Eid, Manias, Bucknall, & Almazrooa, 2014). Below is the geographical table indicating that Saudi Arabia is over the group mean of drug disorders and disabilities resulting drug abuse.





*Circled bar shows values significantly higher than group mean

4.4.1 King Faisal Specialist Hospital and Research Center

This case study was conducted in one of the most advanced hospitals in Saudi Arabia to examine and observe the use of the HIS used. Also, to understand how they manage the abuse patient when coming to the hospital in term of technology use to curb and monitor the issue of abuse.

King Faisal specialist hospital & research center (KFSHRC) is in Riyadh, the capital city of the Kingdom of Saudi Arabia, was opened in 1975 by King Khalid ben Abdulaziz AL Saud. It is a tertiary care center that treats the most difficult cases in the kingdom such as

cancer, liver diseases, genetics, and metabolic, cardiac, and other complicated cases. KFSHRC consist of three big facilities in addition to a big leading scientific clinical research center, these facilities are equipped with the highest technology available in market to promote care provided to patients. Its mission states as "To be a world leader in healthcare through excellence and innovation" while their mission is "provides the highest level of specialized healthcare in an integrated educational and research setting". KFSHRC has automated majority of their workflows in all departments. They launched their electronic health record in 2000 and gradually improved the system through multiple enhancements and upgrades. King Faisal hospital HIS is a Cerner software. Cerner is an American HIS vendor. The HIS is an integrated system and consist of multiple applications such as patient chart that works as the main window for clinicians, laboratory, radiology, pharmacy, and other systems including billing, and serve all the three facilities. KFSHRC had achieved HIMSS 7 level which is an international certificate indicating a full hospital automation with focus on clinical practice automation. The KFSHRC-R branch consist of about 1200 beds including all the departments and latest expansion, staff operating this facility reached 7000 employee including medical and non-medical staff. Their staff are well oriented and trained to use the electronic health record professionally, adopting changes and enhancements of the HIS smoothly.

Multiple mega expansion projects are going on currently to incorporate the significant increase for medical services and meet the transformation process of health care in Saudi Arabia. One of the transformation aspect of health care in the country is to use and optimize the benefits of HIS and digitalization in general. April 2017, the largest specialized center of its kind in the region was opened as a new expansion to Riyadh KFSHRC with capacity of 300 inpatient beds plus infusion center with 96 beds that are equipped with smart technology and enhancing patient experience using technology and entertainment. The KFSH&RC-Jeddah branch Mega Expansion Project is progressing, it

will consist of 1080 beds distributed among different services such as inpatient, emergency, outpatient, dialysis, and other departments. It is expected to be opened and operated by the end of 2020.

Currently, KFSHRC are working now on building a fourth complex in Almadina Almunawarah to serve patient with cancer and other complicated conditions. All these four complexes relate to one standard HSI that share patient information among the whole complexes based on the clinician needs. Patients with Opioids abuse, and even other controlled substance visit the sites and get the drug according to their condition although the facilities apply a very strict dispensing policy.

This hospital was selected as the case study by research for multiple reasons. One important reason is that this hospital is a leading hospital in treating cancer in the region and therefore using a lot of controlled medications including Opioids which may result in developing addition habits to the drug. Another factor is that they have been using the most advanced HIS which is an American software developed by CERNER company. So, research wants to explore the usability of current HIS in curbing the abuse issue and how they are using it and managing the patient with abuse symptoms in term of monitoring and flagging the abuse patient. Other factors include the type of patients visiting whom include abuse patient as well as the services such as the pain clinic that is responsible for dispensing the controlled substance and may contribute to the abuse issue to some extent.

4.4.2 Al-Amal Mental Health Complex

Al-Amal complex, shown in Figure 4.2, is considered as one of the most advanced mental health and addiction center in the region and in the Arab world. It consists of two main hospitals. One is designed to manage and treat addiction disorders patients and the other

one is a psychiatric hospital that treat psychiatric patients who might be addicted patient as well.



Figure 4.2: Al-Amal Complex

The psychiatric hospital was opened in 1983 while the addiction hospital followed later and was opened in 1987. Later, each hospital was gathered in one big complex to facilitate the complexity of managing addiction and psychiatric cases. Many cases start with addicting a substance and end up with a psychiatric disorder, so they need different management in both hospitals. The complex consists of 600 beds divided between both hospitals in addition to the emergency department and outpatient clinics. The complex consists of different services, these include psychiatric health section, addiction section, emergency section, outpatient, laboratory, pharmacy, rehabilitation section, and security section to apply security and safety of staff and buildings. According to the management of the hospital, expansion projects are ongoing due to the increasing numbers of patients particularly addiction that usually leads to a psychiatric disorder, which in turn need a long term follow up and admission when needed. The below figure (Figure 4.3) shows an increasing number of patients admitted to the complex in addition to the outpatient visits and emergency visits as per the statistics department of the hospital.



Figure 4.3: Number of drug addiction/abuse cases presenting to the Alamal hospital for the period 2014-2017, Statistics dept., (Alamal hospital, 2017)

They also have a research center that takes care of all research of the complex in addition to facilitate studies conducted by researchers in the cite. They had provided researcher with all the required support and facilitated all meetings with the informants from both emergency department and pharmacy team. The participants were very helpful although they have been busy all the time. The whole complex with management had been supportive with this study.

4.5 Observation Process in Case Study Sites

Observation allows researcher to deeply engage himself in the care facility studied and documents finding from observing how they practice and behave when managing abuse case as well as normal cases to compare the difference in practice. In this study, observation was conducted to overview how the health care providers are interacting with their existing HIS and how this workflow is implemented. Also, to observe the reaction of patients and their acceptance of the management of their care and reaction of seeking opioids drugs as well as the behavior and how care providers (participants) can deal with this attitude. Observation in a free manner allow for a flexible data collection without impact of different variables (Creswell & Poth, 2017).

According to Kolb (2014), witnessing and attending the conduction of activities and performance of the system targeted permit a great gain of knowledge on system usability and functions. While observation does not involve direct interaction with the system, seeing the participants and the patients interact creates a platform on which experiential knowledge is gained. Observation conducted in both sites was with supported by a singed document from management but with physical contact with patient but only observing the workflow and how participant use the HIS to conduct the job and particularly in managing abuse patients. Observation is done according to a set of process and steps that help in prioritizing and arranging the observation needs and what need to be done to complete the process. Below are the steps used in sequence to perform the observation stage in both sites.



Figure 4.4: Steps of Observation Process Conducted

More elaboration on observation processes and findings of observation will be presented in detail in the next chapter of data analysis along with the rest of the qualitative analysis findings.

4.6 Summary

This chapter presents the case study of the research. Firstly, it presents case study and observation in research design. Then it presents case study on King Faisal Specialist Hospital & Research Center. Then it presents case study on Al-Amal mental health Complex. The results show that, the HIS used in these health complexes are not that much efficient in HIE and controlling the misuse of opioids and control drugs. Thus, it is necessary to design an efficient architecture of HIS to implement in Saudi Arabia.

CHAPTER 5: DATA ANALYSIS AND FINDINGS

5.1 Introduction

This chapter contains data analysis and research results that will answer the research questions. It starts with an overview of the research sites including both hospitals. The study was conducted in two major hospitals located in Riyadh city. The first is a tertiary care center called King Faisal specialist hospital & research center and the second is Riyadh psychiatry hospital that is designed to treat and manage the addiction patients as well as the psychiatric disorders resulting from addiction.

This chapter also contains the analysis of data collected from both research sites using multiple methods such as the questionnaire and a semi structured interview with two groups of participants. The participants in this study were physician and pharmacists dealing with opioids/controlled substance abuse patients. Analysis of data was conducted by using SPSS software for the questionnaire data and thematic analysis to analyze the interview contents. Researcher employed a coding procedure for each participant in both types. Interview data were transcribed from recording and revised several times to ensure content quality and clarity. Themes grouping were built to use in the analysis. This chapter is concluded by discussions of the findings of this study according to the study objectives in the form of resolutions to the research problem by enhancing a HIS workflow processes convenient to curb the epidemic.

5.2 Current HIS workflow Processes Issues

Most of the hospitals and other health organizations in the kingdom of Saudi Arabia are either fully or partially automated. They had adopted an organizational HIS that is integrated with different organizational systems such as radiology information system, laboratory systems and pharmacy information system as well as other components. This integrated system serves only the organization workflow and medical-clinical requirements. Different information system vendors are operating different health organization information system with different operation levels, requirements and functions depending on the required organizational workflows. This initiates the first element of HIE limitation among multiple HISs in the region.

Currently, some of the health organizations and particularly where this study was conducted, had already started some work to leverage the gaps and flaws in their workflows by automating the defected processes when technology can play the intended role in fixing and enhancing the overall performance of the organization to provide a better patient care.

One of the most identified known issues in HISs found post study analysis in both sites and even other sites is lacking the interoperability between different HISs of different health care settings. This results in missing a valuable HIE process among different health care providers. Other issues noticed and pointed include the following.

- No integration in both sites with the rest of the health care facilities to share information.
- Not friendly used resulting in redundancy of opioids prescriptions and the need to print a prescription paper slip.
- System limitation in some sites that does not allow interoperability.
- Low communication level among physician and pharmacist when prescribing opioids repeatedly to abuse misuse patients.
- Funding an interoperable information system considered as an issue.

• Workload particularly in emergency, part of it for opioids prescriptions seeking patients.

5.3 The Pilot Study

The preliminary study of this research was conducted with a random trial method, as the participants may aware or unaware of the opioids abuse issue in Saudi Arabia. The study conducted among the individuals in a similar position and similar educational background to examine the suitability of the questionnaire and interview questions in capturing the right answers for the research questions. The participants were chosen from similar background to avoid bias factor against the research issue. Total of 10 participants from both groups involved in this pilot study. The short end type and well-organized questions were distributed among the participants to improve the willingness of the participants to answer the questions. The questionnaire consists of four themes of participant's perception of the abuse or misuse of opioids issues, their orientation to HISs, HIS integration, and the information exchange process with other health care facilities.

From the pilot study, it is found that:

- Importance of the interviewer role is important as he/she needs to introduce the purpose and aim of the research to the interviewee.
- The interviewer needs to create a good rapport with the interviewee to avoid suspicious on the researcher's motives and to get real answers for the interview questions.

• The answers and discussion of the interviewees during the pilot study helped researcher to refine and rebuild some questions to confirm clarity and reduce confusion to participants.

Some of the research interview questions were re-written after the pilot study to meet the study objectives.

5.4 Data Collection and Participant's Response Rate

Participants of this study were selected from two different health care facilities listed above. Both facilities met the criterion of participant selection which include being an emergency physician, dealing with opioids and narcotics patients, pharmacists who can dispense opioid/controlled substances and dealt with addiction patient. Both informants must be able to use the organization HIS either for documentation or dispensation.

In this study, a total of 40 participants were nominated among others and selected at final stage according to selection criteria. Twenty emergency physician and 20 pharmacists formed the participant's teams from both hospitals 10 participant of each group from each hospital. Pre-interview questionnaire and one to one semi structured interview was conducted.

Prior to study conduction, researcher met with the research office in both organizations to prepare for the study and confirm the informant's eligibility to participate in this study and facilitate researcher access to the hospital environment and plan for interview schedules according to staff convenient times. Consequently, an agreement was signed with the organization research office for this study. Researcher approached the informants to arrange for meetings and assign an alternative time as well, orient them on the study, and have the consent signed. Researcher had visited the participants working

environments and observed workflows, to understand the patient's tour in emergency and how they deal with opioids abuse misuse patients in addition pharmacist workflow processes. Moreover, this would help in understanding how they perform their activities and deal with patients, re-designing the interview questions intended when needed and familiarize researcher with the medical terminology used in such an environment.

Researcher ended up with a response rate of 40 interviews while 37 out of the 40-preinterview questionnaire were completed since there was no need to redo the questionnaire part for the extra 10 participant of the interview second round. The second round was conducted to enrich the data and to gain information saturation where some of the original participants elaborated some points in depth allowing more space for a semi-structured input. The missing numbers of participants were due to the long vacation by targeted healthcare participants, subsequent refusal to participate, conflict of time, and departmental work stress. Researcher believed that data saturation was obtained and reached by the second round of participant's interviews since it was found that about 12– 16 interviews were adequate to achieve thematic saturation (Guest *et al.*, 2017). Response rate was satisfactory for researcher.

Researcher started the analysis by examining the demographics data of the participants of the study to a better understanding of their work nature and personal characteristics that might have an impact on the subsequent analysis and results. The below graphs and tables show the detail of the demographics characteristics of the participants in both the interview and the pre-interview questionnaire. These demographics data were a part of the pre-interview questionnaire completed by participants. These characteristics include gender, profession, age, nationality, and years of experiences in the field. The following graphs and tables include explanation of the findings among the demographics of the participants.

5.5 Results from Questionnaires

		Gender	Age	Nationality	Profession	Years of Experience
N	Valid	37.0	37.0	37.0	37.0	37.0
IN	Missing	0.0	0.0	0.0	0.0	0.0
Mean		1.32	2.51	1.62	1.54	2.19
Std. Deviation		0.475	0.932	0.492	0.505	1.266
Skewness		0.783	0.067	-0.523	-0.170	0.840
Std. Error of Skewness		0.388	0.388	0.388	0.388	0.388
Kurtosis		-1.470	-0.776	-1.828	-2.087	-0.164
Std. Error of Kurtosis		0.759	0.759	0.759	0.759	0.759

Findings: The description table above shows that the independent variables are not normally distributed. According to Chua (2016 p. 365), Skewness measures how symmetrical the data is around the midpoint, while the Kurtosis indicates how quickly the data tails off. The Skewness between -1.96 and +1.96 and Kurtosis between -1.96 and +1.96 can be consistent with a normally distributed data and the p-value should be above 0.05. In this distribution, the skewness/kurtosis reveals that all the variables are normally distributed.

		Frequency	Percent	Valid Percent	Cumulative Percent
	20-30	5	13.5	13.5	13.5
	31-40	14	37.8	37.8	51.4
Valid	41-50	12	32.4	32.4	83.8
	>51	6	16.2	16.2	100.0
	Total	37	100.0	100.0	0

Table 5.2: Age distribution



Figure 5.1: Percentage of Age Distribution

Findings: From the analysis, Table 5.2 shows that the respondents are between ages 20 and above 51 years. From the Table 5.2 and Figure 5.1, ages between 20 and 30 years were 5 (13.5%), ages 31-40 years were 14 (37.8%), ages 41-50 years were 12 (32.4%) while above 51 years of the respondents were 6 (16.2%). This result shows that majority of the respondents were between 31-40 years old.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	25	67.6	67.6	67.6
	Female	12	32.4	32.4	100.0
	Total	37	100.0	100.0	

Table 5.3: Gender Distribution

Figure 5.2: Percentage of Gender Distribution

Findings: Simple percentage analysis was carried out on the data. From the Table 5.3, Male consists of 25 (67.6%), while Females are 12 (32.4%). This implies that there were more male respondents in the study than females (Figure 5.2).

		Frequency	Percent	Valid Percent	Cumulative Percent
	Saudi	14	37.8	37.8	37.8
Valid	Non-Saudi	23	62.2	62.2	100.0
	Total	37	100.0	100.0	

 Table 5.4: Nationality Distribution

Figure 5.3: Percentage of Nationality Distribution

Table 5.4 shows the nationality distribution of the respondents. From Figure. 4.3, 14 (37.8%) of the respondents were Saudi doctors while 23 (62.2%) were non-Saudi Arabian. This shows that there were more non-Saudi in the study than the Saudis (Figure 5.3).

Table 5.5: Profession Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ER Consultant	17	45.9	45.9	45.9
	Pharmacist	20	54.1	54.1	100.0
	Total	37	100.0	100.0	

Figure 5.4: Percentage of Profession Distribution

Findings: From the frequency analysis Table 5.5, it shows that ER Consultants (Physicians) were 17 (45.95%) while the Pharmacists were 20 (54.05%). This implies that there were more Pharmacists who participated in this study than Physicians (Figure 5.4).

\mathbf{C}		Frequency	Percent	Valid Percent	Cumulative Percent	
	5-10	18	48.6	48.6	48.6	
	11-15	8	21.6	21.6	70.3	
Valid	16-20	9	24.3	24.3	94.6	
	>20	2	5.4	5.4	100.0	
	Total	37	100.0	100.0		

Table 5.6: Years of Experiences

Figure 5.5: Percentage of Years of Experience Distribution

Findings: Table 5.6 shows the year of experience of the respondents in the survey. From Figure 5.5, 18 (48.65%) of the respondents have 5-10 years of experience, 8 (21.62%) of the respondents have 11-15 years, 9 (24.32%) of the respondents have 16-20 years, while 2 (5.41%) of the respondents have above 20 years. This shows that respondents between 5-10 years' experience were more in the study as shown in Figure 5.1.

Objective 1: To explore the magnitude of the opioid abuse issues in Saudi Arabia within the context of improper HIS design to identify abuse patients.

	Profession	N	Mean	Std. Deviation	Std. Error Mean
Aware of Abuse issue in Saudi Arabia	ER Consultant	17	4.18	0.951	0.231
	Pharmacist	20	4.35	0.745	0.167
Control of substance is a significant issue	ER Consultant	17	4.47	0.717	0.174
	Pharmacist	20	4.40	0.754	0.169
Patient Education	ER Consultant	17	3.94	1.088	0.264
	Pharmacist	20	3.90	1.165	0.261
Visible actions and efforts	ER Consultant	17	3.53	0.943	0.229
	Pharmacist	20	3.90	0.912	0.204

Table 5.7: T-Test (Group Statistics)

Levene's Test for Equality t-test for Equality of Means of Variances 95% Sig. (2-tailed) Confidence Std. Error Mean Interval of the F Sig. Df t Difference Difference Difference Lower Upper Equal variances 0.792 0.380 -0.622 35.0 0.538 -0.174 0.279 -0.740 0.393 assumed Aware of Abuse issue in Saudi Equal Arabia variances 30.144 0.285 -0.755 0.407 -0.610 0.547 -0.174 not assumed Equal variances 0.032 0.859 0.290 35.0 0.773 0.071 0.243 -0.423 0.564 Control of assumed substance is a significant Equal issue variances 0.291 34.521 0.773 0.071 0.242 -0.422 0.563 not assumed Equal variances 0.380 0.542 0.110 0.913 0.041 0.798 35.0 0.373 -0.716 assumed Patient Education Equal variances 0.912 -0.712 0.794 0.111 34.662 0.041 0.371 not assumed Equal variances 0.690 -1.213 -0.991 0.250 0.162 35.0 0.233 -0.371 0.306 assumed Visible actions and efforts Equal variances -1.209 33.641 0.235 -0.371 0.306 -0.994 0.252 not assumed

Table 5.8: Independent Samples Test

Findings: The results of running an independent sample t-test showed that no statistically mean differences existed in awareness of the controlled substance abuse/misuse issue in Saudi Arabia, t (30.14)=-0.610, p>0.05 between ER Consultant N=17 (M=4.18, SD=0.951) and Pharmacist 20 (M=4.35, SD=0.745), also, there is no statistically mean differences existed in control of substance/opioids abuse/misuse is a significant issue in the country with t (34.52) = 0.291, p>0.05 between ER Consultant N=17 (M=4.47, SD=0.717) and Pharmacist 20 (M=4.40, SD=0.754), furthermore, there is no statistically mean differences existed in making patient aware of substance/opioids abuse/misuse side effects with t (34.66)= 0.111, p>0.05 between ER Consultant N=17 (M=3.94, SD=1.088) and Pharmacist 20 (M=3.90, SD=1.165), and lastly, the independent sample t-test showed there is no statistically mean differences existed in recognizing the visible actions and efforts taken to control substance/opioids abuse/misuse in Saudi Arabia t (33.64)= -1.209, p>0.05 between ER Consultant N=17 (M=3.53, SD=0.943) and Pharmacist 20 (M=3.90, SD=0.912).

From the analysis, it shows that there is no significant relationship between the ER Consultant (Physicians) and the Pharmacists. The mean and standard deviation as well as the Levene's Test for Equality of Variances show the amount variance in each of dependent variables on the profession. Therefore, it can be concluded by looking at the mean profession values that the ER Consultants and the pharmacists are aware of the existence of abuse, misuse issues in the country and all agreed that it is a very significant, alerting issue requiring official's attention. They also feel patient education is more vital to the patients to control opioids/ abuse/misuse in Saudi Arabia. Also, in terms of visible actions and efforts, the mean profession showed that they were equally able to visualize effort and actions taken so as to curtail the substance/opioids abuse/misuse among the Saudi Arabian patients (Table 5.7).

Objective 2: To identify the current process on prescribing Opioids drug using HIS in Saudi Arabia while exploring physician/pharmacist perception on current HIS use regarding Opioids drug abuse.

		N	Maar	Std Designation	644 E	95% Confidence Interval for Mean	
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
	ER Consultant	17	4.35	0.996	0.242	3.84	4.87
Technological Value in Health Caro	Pharmacist	20	4.20	0.768	0.172	3.84	4.56
Care	Total	37	4.27	0.871	0.143	3.98	4.56
	ER Consultant	17	4.53	0.717	0.174	4.16	4.90
HIS provides cares in Health	Pharmacist	20	4.55	0.759	0.170	4.19	4.91
care for patients	Total	37	4.54	0.730	0.120	4.30	4.78
Confidents in	ER Consultant	17	4.35	0.862	0.209	3.91	4.80
HIS Providing efficient health care	Pharmacist	20	4.40	0.681	0.152	4.08	4.72
	Total	37	4.38	0.758	0.125	4.13	4.63
Used E- Prescription in prescribing	ER Consultant	17	4.94	0.243	0.059	4.82	5.07
	Pharmacist	20	4.85	0.366	0.082	4.68	5.02
medications	Total	37	4.89	0.315	0.052	4.79	5.00
	ER Consultant	17	4.29	1.312	0.318	3.62	4.97
E-Prescription Systems	Pharmacist	20	4.70	0.470	0.105	4.48	4.92
	Total	37	4.51	0.961	0.158	4.19	4.83
Hospital has	ER Consultant	17	2.71	1.929	0.468	1.71	3.70
electronic system to track, monitor patient	Pharmacist	20	2.75	1.916	0.428	1.85	3.65
	Total	37	2.73	1.895	0.312	2.10	3.36
	ER Consultant	17	4.65	0.606	0.147	4.34	4.96
HIS Control and minimize abuses	Pharmacist	20	4.55	0.759	0.170	4.19	4.91
	Total	37	4.59	0.686	0.113	4.37	4.82

 Table 5.9: Descriptive (95% Confidence Interval for Mean)

	Levene Statistic	df1	df2	Sig.
Technological Value in Health Care	1.797	1	35	0.189
HIS provides cares in Health care for patients	0.031	1	35	0.862
Confidents in HIS Providing efficient health care	0.423	1	35	0.519
Used E-Prescription in prescribing medications	3.377	1	35	0.075
E-Prescription Systems	5.589	1	35	0.024
Hospital has electronic system to track, monitor patient	0.016	1	35	0.901
HIS Control and minimize abuses	1.194	1	35	0.282

Table 5.10: Test of Homogeneity of Variances

Findings: To examine the current use of HIS in multiple health organizations and their HIE capabilities, One-Way (ANOVA) was carried out to analyze the data. The results of running One-Way (ANOVA) showed that a statistically mean difference existed in the awareness of the technological value and impacts in health care organizations in Saudi Arabia but not significant p>0.5, ER Consultant N=17 (M=4.35, SD=0.996), while Pharmacist 20 (M=4.20, SD=0.768). A test of Homogeneity of variance showed that there is a variation in opinion by the respondents and that having electronic system in hospitals

which can track and monitor patient against opioids abuse/misuse in Saudi Arabia is necessary (Table 5.10). The Levene statistics showed lower mean for hospitals having esystem that can track and monitor patients in Saudi Arabia. The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic (1.797) was not significant at p > 0.05. This implies that an interoperable electronic system that can track and monitor patients electronically against abuse/misuse in patients is necessary in Saudi Arabia hospitals. Furthermore, One-Way (ANOVA) showed that slightly statistically mean difference existed in having the experience to work in a health care setting that uses HIS to provide patient care services in Saudi Arabia but not significant p>0.5, ER Consultant N=17 (M =4.53, SD=0.717), while Pharmacist 20 (M=4.55, SD=0.759). A test of Homogeneity of variance shows that there is a significant variation among care providers who are working in a health care setting that uses a HIS to provide patient care services in Saudi Arabia. Also, the Levene statistics shows the impact of having HIS in a place of work and services given to the patients by these professions. The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic was low (0.031) but not significant at p > 0.05. This implies that working in a health care setting that uses HIS to provide patient care services would help in the services given by these doctors and pharmacists in their various organizations and lack of it would have negative technological impacts in their services to the patients in Saudi Arabia, including the opioids and other controlled substances abuse misuse patients.

Equally, One-Way (ANOVA) showed that a statistically mean difference existed in having a confidence that HIS provides the efficiency needed when giving patient care within health care facilities in Saudi Arabia but, still not significant p>0.5, ER Consultant N=17 (M=4.35, SD=0.862), and Pharmacist 20 (M=4.40, SD=0.681). A test of Homogeneity of variance shows that there is a statistic significant difference in perception between the doctors and being confident that HIS provides the efficiency needed when

giving patient care in Saudi Arabia. Besides, the Levene statistics shows the impact of having HIS as a basis for given patients care by the doctors. The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic (0.423) but not significant at p> 0.05. This implies that the respondents were having the confidence that HIS would provide the efficiency needed to give patient the necessary care within health care facilities in Saudi Arabia and that, subsequently affect positively abuse misuse patients within this organization (Table 5.9 and Table 5.10).

Also, the results of running One-Way (ANOVA) showed that a statistically mean difference existed in the usage of electronic prescribing system (e-prescription) among the doctors in Saudi Arabia however, not significant p>0.5, ER Consultant N=17 (M=4.94, SD=0.243), Pharmacist 20 (M=4.85, SD=0.366). A test of Homogeneity of variance shows that there is a variation and significant difference in the usage of electronic prescribing system (e-prescription) by the doctors and pharmacists in Saudi Arabia. The Levene statistics shows the impact of the usage of electronic prescribing system (e-prescription) and services rendered to the patients by the doctors in Saudi Arabia. Yet, the degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic (3.377) was not significant. This implies that even though the doctors and pharmacists have used or using e-prescription in discharging their duties at various organizations to the patients, this does not necessarily translate in the way they practice it especially among the pharmacists (Table 5.9 and Table 5.10). Therefore, it can be concluded that more emphasis must be placed on the practices and usage of e-prescription by the doctors and pharmacists when discharging their duties or dispensing medications in their organizations.

In contrary, One-Way (ANOVA) showed that a statistically mean difference existed in the perception about e-prescription systems that provides a safer, quicker, and accurate prescription among the doctors in Saudi Arabia, but significant at p<0.05., ER Consultant

N=17 (M =4.29, SD= 1.312), while Pharmacist 20 (M=4.70, SD=0.470). A test of Homogeneity of variance shows that there is a statistically significant relationship in e-prescription systems that provides a safer, quicker, and accurate prescription practice between doctors (ER Consultant and the Pharmacists) and the patients in Saudi Arabia. Further analysis of the Levene shows the impact e-prescription has on the correctness of prescription, safety, and fast delivery of services to their patients.

The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic was very high (5.589) and significant at p<0.05. Next analysis showed slight statistically mean difference existed in the hospitals using electronic systems to track and monitor patient's controlled-substances dispensing history from other facilities in the region but, not significant p>0.5, ER Consultant N=17 (M =2.71, SD= 1.929), and Pharmacist 20 (M=2.75, SD=1.916). A test of Homogeneity of variance shows that there is a statistic significant difference in perception among the doctors using E-Systems that track, monitor patient's-controlled substances dispensing history from other facilities in the region in Saudi Arabia. In addition, the Levene statistics shows the impact of E-Systems on the patient's-controlled substances dispensing history by the doctors.

The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levine statistic was low (0.065) but not significant at p>0.05. This implies that implementing and having an electronic system that track, and monitor patient's-controlled substances dispensing history is good, but there is no evidence between its effectiveness and controlling the opioids/substance abuse or misuse in patients in that region presently since the system is yet to be implemented, therefore, conscientious effort is needed from stakeholders (doctors and pharmacists and other health practitioners) and government authorities to implement an interoperable e-system to monitor and track opioids abuse misuse patients in all organizations so that its effectiveness and efficiency can be monitored and measured

especially when drugs are administered to the patients, monitoring abnormalities in them as well as tracing their history.

Lastly, on the usage of HIS playing a significant role in curbing abuse/misuse issues in multiple health organizations, the results of running One-Way (ANOVA) equally revealed that a statistically mean difference existed in doctors' opinion and HIS playing a crucial role in minimizing the control substances or abuse issues in patients in Saudi Arabia but not significant p>0.5, ER Consultant N=17 (M=4.65, SD=0.606), and Pharmacist 20 (M=4.55, SD=0.759). A test of Homogeneity of variance shows that there is a variation and significant difference in the opinion of doctors towards current HIS playing a crucial role in minimizing the control substances or abuse issues in patients in Saudi Arabia. The Levene statistics shows that doctors are discrete about HIS playing a significant role in controlling the controlled substances misuse/abuse issue in patients.

However, the degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic (1.194) was not significant (Table 5.9, and Table 5.10). This implies that there is no relationship between the opinion of both ER Consultant, Pharmacist and HIS minimizing the controlled substances/abuse in patients in Saudi Arabia. From the on-going, we can sum up our findings that nevertheless the current use of HIS in the health organizations is evident among the professions (ER Consultants and Pharmacists) in Saudi Arabia, the effectiveness of it cannot be guarantee based on the opinion of the participants in this study.

		N	Mean	Std. Deviation	Std. Error
Internation Technology	ER Consultant	17	4.47	0.624	0.151
Integration Technology helps in control substance in Saudi Arabia	Pharmacist	20	4.40	0.503	0.112
in Saudi Arabia	Total	37	4.43	0.555	0.091
Implementing an Interoperable, Centralized Prescription drug to reduce death	ER Consultant	17	4.29	0.920	0.223
	Pharmacist	20	4.60	0.598	0.134
reduce death	Total	37	4.46	0.767	0.126
discourage to dispense	ER Consultant	17	4.53	0.874	0.212
control substance	Pharmacist	20	4.20	1.361	0.304
Discourage	Total	37	4.35	1.160	0.191
	ER Consultant	17	4.65	0.702	0.170
Doctor shopping	Pharmacist	20	4.70	0.733	0.164
	Total	37	4.68	0.709	0.117
	ER Consultant	17	4.41	0.870	0.211
Prescription Implementation of drug	Pharmacist	20	4.65	0.489	0.109
	Total	37	4.54	0.691	0.114
	ER Consultant	17	2.06	0.899	0.218
Innovation of Privacy if implemented	Pharmacist	20	2.20	1.576	0.352
1	Total	37	2.14	1.294	0.213
	ER Consultant	17	4.47	0.514	0.125
Positive Feedback using HIS	Pharmacist	20	4.55	0.510	0.114
	Total	37	4.51	0 0.503 3 0.555 0 0.920 0 0.598 5 0.767 3 0.874 0 1.361 5 0.702 0 0.733 3 0.709 1 0.691 5 0.489 4 0.691 5 0.870 5 0.489 4 0.691 5 0.514 5 0.514 5 0.514 6 0.475 5 0.702 5 0.702 5 0.702 6 0.514 7 0.514 9 0.410 8 0.475 5 0.702 5 0.224 1 0.518 4 4.205 5 3.300 8 5.432	0.083
	ER Consultant	17	4.53	0.514	0.125
Technology is a must	Pharmacist	20	4.80	0.410	0.092
	Total	37	4.68	0.475	0.078
Interoperable centralize	ER Consultant	17	4.65	0.702	0.170
prescription drug monitoring sys implemented	Pharmacist	20	4.95	0.224	0.050
	Total	37	4.81	0.518	0.085
MD Paraantian on UIE P-	ER Consultant	17	46.94	4.205	1.020
DRUG MONITORING	Pharmacist	20	39.05	3.300	0.738
848	Total	37	42.68	5.432	0.893

Table 5.11 Descriptive of the Opinion of the Participants

	Levene Statistic	df1	df2	Sig.
Integration Technology helps in control substance in Saudi Arabia	1.923	1	35	0.174
Implementing an Interoperable, Centralized Prescription drug to reduce death	3.066	1	35	0.089
discourage to dispense control substance Discourage	2.480	1	35	0.124
Doctor shopping	0.135	1	35	0.716
Prescription Implementation of drug	4.121	1	35	0.050
Invasion of Privacy if implemented	9.850	1	35	0.003
Positive Feedback using HIS	0.054	1	35	0.818
Technology is a must	8.761	1	35	0.005
Interoperable centralize prescription drug monitoring sys implemented	17.204	1	35	0.000
MD Perception on HI EXCHANGE & DRUG MONITORING SYS	0.698	1	35	0.409

Table 5.12: Test of Homogeneity of Variances

To examine the HIE perception among the doctors, and interoperability capabilities, it is equally conducted One-Way (ANOVA) to analyze the data. The results of running One-Way (ANOVA) showed that a statistically mean difference existed in the opinion that integrating technology for exchanging information such as controlled substance would help resolve the controlled abuse/misused in Saudi Arabia but not significant p>0.5, ER Consultant had N=17 (M =4.47, SD= 0.624), while Pharmacist 20 (M=4.40, SD=0.503). A test of Homogeneity of variance shows that there is a variation and significant difference in the perception of the doctors towards the integration of technology for exchange information such as controlled substance would help resolve the controlled abuse/misused in Saudi Arabia. The Levene statistics shows the impact of integration technology for exchange information would help to resolve the controlled abuse/misused in Saudi Arabia. The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic (1.923) was not significant at p>0.05. This implies that the current integration of technology for exchange information does not have a relationship in the way the doctors perceived its control over the prescription drug abuse/misuse in Saudi Arabia.

Also, the results of running One-Way (ANOVA) showed that a statistically mean difference existed in the opinion that implementing an interoperable, centralized prescription drug monitoring system would reduce the abuse misuse deaths between the physician and pharmacists in Saudi Arabia but, slightly not significant p>0.5, ER Consultant had N=17 (M =4.29, SD=0.920), while Pharmacist 20 (M=4.60, SD=0.598). A test of Homogeneity of variance shows that there is a variation and significant difference in implementing an interoperable, centralized prescription drug monitoring system that can reduce deaths from drug abuse/misused and overdose between the physicians and pharmacist's opinions in Saudi Arabia. The Levene statistics shows the degree of freedom 1 (1) and degree of freedom 2 (35) to be (3.066) but not significant
(Table 5.12). This implies that even though the physicians and pharmacists recommend a drug monitoring system to reduce deaths arising from misuse/abuse and overdose, there is no correlation in their opinions as to how effective the prescription drug monitoring system would be to protecting patients as they lack the system in place presently. Hence, a closer future study is needed when such a system is implemented to ascertain the effectiveness of the system as suggested by the physicians, pharmacists, and legislation authorities.

Next analysis showed a statistically mean difference existed in doctors' reactions to implementation of an E-prescription drug monitoring system with no significant at p>0.5, ER Consultant N=17 (M =4.53, SD=0.874), and Pharmacist 20 (M=4.20, SD=1.361). A test of Homogeneity of variance shows that there is a statistic significant difference between perception on HIE of the doctors and the implementation of an electronic prescription drug monitoring system in Saudi Arabia. In addition, the Levene statistics shows the effect of implementing E-prescription drug monitoring systems targeting the suspected abuse misuse patients (especially among the pharmacists, Table 5.12). The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic was high (2.480) and not significant. This means that having an electronic prescription drug monitoring system could also affect positively both the doctors and the pharmacists' decision to order opioids to the suspected abused patients if implemented, and so both professions believed that implementing an E-prescription drug monitoring system in Saudi Arabia would go a long way in monitoring drug abuse or misuse among the patients.

On contrary, One-Way (ANOVA) revealed that a statistically mean difference existed in the perception of the physicians and pharmacists about implementing e-prescription drug monitoring system to reduce the cost of admission and ER visits significant at p<.05, ER Consultant N=17 (M=4.41, SD=0.870), while Pharmacist 20 (M=4.65, SD=0.489).

Similarly, there is a statistically mean difference existed in the perception of the both physicians and pharmacists towards implementing e-prescription drug monitoring systems to be an invasion of patients' privacy in Saudi Arabia, yet, significant at p<0.003, ER Consultant N=17 (M =2.06, SD=0.899), while Pharmacist 20 (M=2.20, SD=1.576). Likewise, the perception that Technology is a must for effectively delivering health care services was significant at p<0.005, with Mean differences in ER Consultant N=17 (M =4.53, SD=0.514), while Pharmacist 20 (M=4.80, SD=0.410).

More so, a mean difference existed in the perception that an interoperable, centralized prescription drug monitoring system should be implemented in Saudi Arabian health care facilities also significant at (p<0.005) ER Consultant N=17 (M =4.65, SD=0.702), while Pharmacist 20 (M=4.95, SD=0.224). A test of Homogeneity of variance shows that there is a statistically significant relationship in the perception of the both (ER Consultant and the Pharmacists) about implementing e-prescription drug monitoring system to reduce the cost of admission and ER visits in Saudi Arabia, also, statistically significant relationship existed in the perception of both participants towards implementing e-prescription drug monitoring systems to be an invasion of patients privacy, more so, the perception that technology is a must for effectively delivering health care services was also significant and the perception that an interoperable, centralized prescription drug monitoring system should be implemented in Saudi Arabian health was equally significant. The degree of freedom 1 (1) and degree of freedom 2 (35) show that the Levene statistic was very high in all the constructs and significant (Table 5.12). This indicates that there is a relationship between implementing e-prescription drug monitoring system and reduction in the cost of admission and ER visits, also, a relationship exists in implementing e-prescription drug monitoring systems and invading patients' privacy, also, a relationship exists in considering technology is a must for effectively delivering health care services, and

finally, a relationship exists in centralizing prescription drug monitoring system and the way both doctors and pharmacists perceived them in Saudi Arabia.

Objective 3: To propose an interoperable, integrated HIS workflow processes capable of mitigating abuse issues in Saudi Arabia.

In this analysis, we must look at it in parallel with the same objective results in the interview analysis part.

		Profe	Profession		
	Ġ		ER Consultant	Pharmacist	Total
		Count	1	2	3
Support Health Care Digitization	Neutral	% of Total	2.7%	5.4%	8.1%
		Count	3	7	10
	Agree	% of Total	8.1%	18.9%	27.0%
	Strongly	Count	13	11	24
	Agree	% of Total 35.1% 29.7%	29.7%	64.9%	
Total		Count	17	20	37
		% of Total	45.9%	54.1%	100.0%

 Table 5.13: Support Health Care Digitization * Profession Crosstabulation



Figure 5.6: Support for Health Care Digitization

To determine the participants' perception towards management support for health care digitization, cross tabulations analysis was carried out. Table 5.13 compares the management support for health care digitization between ER Consultants and the Pharmacists. The result showed that the highest percentages count within the support for health care digitization of ER Consultants were 16 (43.2%) while that of the Pharmacists were 18 (48.6%). On the other hand, the number of ER Consultant who indicated Neutral was 1 (2.7%), while those of Pharmacists were 2 (5.4%). In comparison between the total count for management support for health care digitization (54.1%) compared to the (ER Consultant) Physicians. This implies that both physicians and pharmacists were the highest.

			Profession			
			ER Consultant Pharmacist		Total	
	Strongly	Count	1	1	2	
	Disagree	% of Total	2.7%	2.7%	5.4%	
		Count	2	1	3	
	Disagree		2.7%	8.1%		
Tracking monitoring	Neutral	Count	4	7	11	
is a concern to management		% of Total	10.8%	18.9%	29.7%	
	S	Count	4	4	8	
	Agree	% of Total 10.8% 10.8%	10.8%	21.6%		
	Strongly Agree	Count	6	7	13	
		% of Total	16.2%	18.9%	35.1%	
		Count	17	20	37	
Total		% of Total	45.9%	54.1%	100.0%	

Table 5.14: Tracking monitoring is a concern to Management * Profession Crosstabulation



Figure 5.7: Tracking and Monitoring of Abuse, Misuse Patients is a Concern to Management

Further cross tabulation analyses were performed to investigate whether tracking and monitoring of controlled substances abuse/misuse system is a major concern to the top management in respondents' organization. Result of the above Table 5.14 and Figure 5.7 indicate that the highest percentages of agreement that the tracking and monitoring of controlled substances abuse/misuse system is a major concern to the top management, for ER Consultants were 10 (27.0%) while that of the Pharmacists were 11 (29.7%). On the other hand, the total number of ER Consultant who disagreed with the statement were 3 (8.1%), while those of Pharmacists that disagreed were 2(5.4%). Those that feel indifferent were just 2 (5.4%). In comparison between the total count for agreeing that tracking and monitoring of controlled substances abuse/misuse system is a concern to the top management in respondents' organization, Pharmacists believe management provide more support for health care digitization (54.1%) compared to the (ER Consultant)

Physicians (45.9%). This implies that both physicians and pharmacists were in support for tracking and monitoring controlled substances abuse/misuse system in the organization driven by management support. But the majority were the Pharmacists.

			Profession		
			ER Consultant	Pharmacist	Total
	Strongly	Count	1	0	1
	Disagree	% of Total	2.7%	0.0%	2.7%
	Discourse	Count	0	1	1
	Disagree	% of Total	0.0%	2.7%	2.7%
Hospital Management	3	Count	3	4	7
provides support	Neutrai	% of Total	8.1%	Pharmacist 0 0.0% 1 2.7% 4 10.8% 7 18.9% 8 21.6% 20 54.1%	18.9%
		Count	7	7	14
	Agree	% of Total	18.9%	18.9%	37.8%
	Strongly	Count	6	8	14
	Agree	% of Total	16.2%	21.6%	37.8%
Total		Count	17	20	37
		% of Total	45.9%	54.1%	100.0%

 Table 5.15: Hospital Management provides support * Profession Crosstabulation



Figure 5.8: Hospital Management Provides Support System Implementation

The comparison between the respondents' perception and hospital management support is presented in Table 5.15 and Figure 5.8. The findings demonstrated that about 13 (35.1%) of the ER Consultants were in the agreement that hospital management will provide sufficient and effective support to implement such a system, while that of the Pharmacists were 11 (29.7%). On the contrary, the total number of ER Consultant who disagreed with the beliefs were 3 (8.1%), while those of Pharmacists that disagreed were 2 (5.4%). Also, those that feel indifferent were 3 (8.1%) for ER Consultant and Pharmacists were 4 (10.8%). To show the comparison between the total counts for profession who beliefs that hospital management will provide sufficient and effective support to implement the system, Pharmacists were (54.1%) while the Physicians (ER Consultant) were (45.9%). From the result, it implies both agree with the statement, but the majority of the Pharmacists were more confident that hospital management will provide sufficient and effective support to implement the prescription drug monitoring and tracking system to eliminate opioids abuse, misuse issues.

			Profession ER Consultant Pharmacist		Total
	Strongly	Count	0	2	2
	Disagree	% of Total	0.0%	5.4%	5.4%
	D:	Count	1	0	1
	Disagree	% of Total	2.7%	0.0%	2.7%
Incentives increases acceptance	Neutral	Count	4	2	6
		% of Total	10.8%	5.4%	16.2%
	5	Count	5	11	16
	Agree	% of Total	13.5%	2 5.4% 11 29.7% 5	43.2%
	Strongly Agree	Count	7	5	12
		% of Total	18.9%	13.5%	32.4%
Total		Count	17	20	37
		% of Total	45.9%	54.1%	100.0%

 Table 5.16: Incentives increases acceptance * Profession Cross tabulation



Figure 5.9: Incentives Increases Acceptance

To determine the participants' perception towards management incentivizing users' acceptance to use and interact with the integrated E-Systems and control the abuse were carried out using cross tabulations. Table 5.16 compares the management incentivizing between ER Consultants and the Pharmacists. The result showed that the highest percentages count within the support for management incentivizing of ER Consultants were 12 (32.4%) while that of the Pharmacists were 16 (43.2%). Those that disagreed with management incentivizing were 1 (2.7%) for ER Consultants while Pharmacists were 2 (5.4%). On the other hand, the number of ER Consultants who indicated Neutral were 4 (10.8%), while that of Pharmacists were 2 (5.4%). In comparison between the total count for management support for incentivizing users to accept and interact with such an interoperable system, Pharmacists obtained more confidence (54.1%) compared to the (ER Consultant) Physicians (45.9%) that incentives would increase the acceptance and ease the adoption of the integrated, interoperable tracking and monitoring system.

			Profession ER Consultant Pharmacist		
					Total
Willing to participate in design and implementation		Count	2	0	2
		% of Total	5.4%	0.0%	5.4%
	Agroo	Count	5	9	14
	Agree	% of Total	13.5%	24.3%	37.8%
	Strongly	Count	10	11	21
	Agree	% of Total	27.0%	29.7%	56.8%
Total		Count	17	20	37
		% of Total	45.9%	54.1%	100.0%

Table 5.17: Willing to participate in design and implementation * ProfessionCrosstabulation



Figure 5.10: Willing to Participate in Design and Implementation

We equally carry out cross tabulation analyses to determine the willingness to participate in the design and implementation of the system by the participants. Result of the above Table 5.17 and Figure 5.10 indicate that the highest percentages of those that are willing to participate in the design and implementation of the system for ER Consultants were 15 (40.5%) while that of the Pharmacists were 20 (54.0%). On the other hand, the total number of ER Consultant who were in neutral with the statement were 2 (5.4%), while those of Pharmacists that were neutral 0 (0.0%). In comparison between the total count for willingness to participate in the design and implementation of the system, both professions had a strong interest to participate in the design and implementation of the systems, but Pharmacists had more interest in participation (54.1%) probably because they are more in the study compared to the (ER Consultant) Physicians (45.9%).

			Profes	ssion	
			ER Consultant	Pharmacist	Total
		Count	7	8	15
provide management	Agree	% of Total	18.9%	21.6%	40.5%
supports	Strongly Agree % of Total	Count	10	12	22
		% of Total	27.0%	32.4%	59.5%
Total		Count	17	20	37
		% of Total	45.9%	54.1%	100.0%

Table 5.18: Provide Management Supports * Profession Crosstabulation



Figure 5.11: Provide Management Supports

Further analyses revealed that providing management support will positively affect users' attitude towards using an interoperable prescription drug monitoring system. Result of the above Table 5.18 and Figure 5.11 indicate that the highest percentages of those that were in support of the statement for ER Consultants 17 (45.9%) while that of the Pharmacists were 20 (54.1%). There is no disagreement or indifferent among the professions. This implies that overwhelming majority of the profession (ER Consultants and Pharmacists) believe that providing management support will positively affect users' attitude towards using an interoperable prescription drug monitoring system.

5.6 **Results from Observation**

The researcher observed both King Faisal Specialist Hospital and Riyadh Mental Complex as part of the data collection to understand the current use of HIS's by participants in curbing and managing abuse patients. The observation done parallels with the interview sections by frequent visits to both hospitals at different working shifts. This approach helps to meet various people at their convenient time and also to observe the existence of distinct work patterns based on peculiar times of the day.

Through the observation, the researcher could see and understand the working environment of the participants from different aspects. For example, how they are managing patients during the whole patient tour in the hospital using the HIS in hand. The researcher also able to watch the degree of the participants' technology adoption as well as other users with the frustrating point of the system usability.

Researcher observation concerns focused on:

- 1. How were the selected participants working environment in both hospitals?
- 2. How are participants currently using the HIS to identify abuse patients?
- 3. How do they perceive the use of their current HIS in controlling abuse issues?
- 4. What are the factors that minimize the use of HIS in controlling opioids abuse issues?
- 5. What are the requirements they miss to enhance the use of the HIS in mitigating the Opioid or other controlled substance abuse issues in particular?

The researcher observed that in King Faisal Specialist Hospital, the workflow process is fully automated, and there is no usage of paper at any stage of patient management. Physicians use the HIS for all stages of procedures of registration, screening, documentation, orders, and discharge of the patients. The system in this hospital is well designed to serve different needs of the clinical health care providers and is customizable to their future needs and modifications. The patient is in a single room; the doctor reviews the system to familiarize patient history and complaints before going to see the patient. This gives the doctor the chance to get any information about the patient history of abuse, if exist within their local system in terms of frequent visits seeking the same medication, or history of drug dispensation that is doubtful. After the patient check-up, the doctor documented his findings in HIS and placed an order for a prescription. The prescription is based on patient needs through his clinical judgment, and by considering the hospital policies. The only paperwork that still exists was the printable version of the controlled prescription, as this a practice according to government policies. The patient then goes to the pharmacy to collect the medication, where pharmacists use the same HIS to check orders and dispense drugs. It is another stage of pharmacists' validation on the physician order against any mistake or doubt of dispensing opioids or other controlled substances to an abusive patient.

In Riyadh Medical Complex, the workflow closely like the one in King Faisal hospital except that patient goes to the doctor's office to be seen instead of being assigned to a single room where the doctor visits the patient. On patient arrival at the doctor's room, the doctor checks the HIS for the history review and then examine the patient. Later, prescription orders are placed in the system. The patient goes pharmacy to collect the drug with a copy of the controlled prescription if needed. The only difference exists between the two hospitals in their workflow, where the Riyadh Medical Complex has a paper chart to document the drugs and history of the patient in additional to their HIS. This is to keep a duplicated reference in their hands for any reason the system is down since most of their patient are addictive psychiatric patients, and most of the period need urgent intervention.

The researcher noticed a few differences in functionalities, capabilities, comprehensiveness, and acceptance of the HIS in both study sites, although both systems had served their organizational needs. King Faisal Specialist Hospital's HIS is a software

of a known technology firm called CERNER and comprehensive and supportive in terms of integration with multiple applications such as laboratory, radiology, and pharmacy system, which facilitate the physicians and pharmacist access to all needed information at the right time. All information need for a prompt and safe decision is available, stored, and accessible by care providers. While the system in RMC is locally built-in and still needs enhancements related to integration with other local applications and the front-end layout. During the observation, the researcher had notice multiple access difficulties by users. Unfortunately, both facilities are not integrating with other external HIS's at any level; therefore, no exchange of patient information occurs. The absence of information exchangeable from an external resource may contribute negatively to the efforts of curbing and mitigating opioids abuse issues as well as other controlled drugs. The lack of exchangeable patient information among health care facilities resulted in poor clinical decision process in term of managing abuse patient all over the kingdom of Saudi Arabia, can lead to an increase of the abused patient due to the absence of vital information in the hand of care providers.

Table 5.19: Observation Report

	Observation Report
Site:	King Faisal Specialist Hospital and Research Center
Department:	Emergency Department
Date:	18 th March 2018
Туре:	Observation on patients visits and application of HIS in clinical settings
 On patient a process took by all health The nurse in to check-up. purpose. The and complain screening are Most of the doctor is rea The research process besi patient histor complaint w Lack of patied dependent of Physicians u The resistant was noticed. Poor completechnology t 	urrival, the registration was conducted by the registration team. The less than 30 seconds, and patient record has seen on the HIS system care staffs. the screening room called the patient's name appearing on the system The nurse uses nursing documentation forms built-in the HIS for this e process took about 5-10 minutes to depend on the severity of the cas ints of the patient. A time-consuming process was observed in the ea. time, the patient goes to the waiting room or empty room until the dy to see him/her. her joined the physician reviewing section and witnessing the whol des interviewed him/her. The doctor accessed the HIS to review the ry and previous visit, medication, and read old notes to link the new ith the old records. Doctors goes to see the patients. ent information exchanges with other external HIS exist. Doctors were n the local HIS within the organization to decide. unhappy with the lack of information exchangeable of the patient ce of the policies in terms of checking the system for abuse suspicion iance of policies in terms of patient management and usage of to mitigate it was observed.
Lack of acculack of acculack of detaiThe prescrip	led documents, although the patient was an abusive patient. otion paper was printed and gave to a patient only if it is a controlle
 drug; otherw Patient infor arrival throw 	mation and prescription orders accessible by the pharmacist on patier of their ID
 In pharmacy Hospital pol 	<i>icies</i> are strictly applied to all drug types.
• Frequent con and quantitie	nmunication between pharmacists and physicians in clarifying order es, particularly for a controlled drug was observed.

- The patient took a long waiting hour in pharmacy was noticed, and it was a problem for patients.
- Lack of an integrated system to validate drug history of the patient with other HIS in pharmacy also exist in the same organization.

Based on the observation findings and analysis, the researcher was able to draw the current workflow processes of the HIS used in both facilities. This drawing of the workflow applied allowed the researcher to identify gaps in the current HIS process and areas for a possible change of improvements. The gap identified and supported by finding from both the survey and the face-to-face interview conducted was the lack of HIE with external HIS to allow the flow of patient information on the time that helps in the decision-making process.

There are several HIS types available, for example: Electronic Medical Record (EMR) and Electronic Health Record (EHR), Practice Management System, Patient Portal, Clinical Decision Support (CDS), Remote Patient Monitoring (RPM), etc. Some notabe HIS could be mentioned as, Aarogya, eHospital, eVisit, myNapier, Insta HMS, Soft Clinic HIS, Caresoft Hospital Information System, Intelligent Medical Software (IMS), Medstar HIS, MMI Mediface, MocDoc HMS, ProMED, MediSteer by Adroit, Mediware, Trio HIS, and so on. None of the above systems followed a well balanced complete architecture in designing the HIS. Below is the diagram that represents the proposed process of HIS architecture by emphasizing the process of identifying the abused patient from the physician and pharmacist perspective.



Figure 5.12: Current HIS Workflow Processes in Use

Both study conduction sites had formulated based on their own workflows to incorporate the HIS processes. King Faisal specialist hospital is totally automated workflow involving HIS interfaces but within the organization. They had imbedded their HIS functions as part of the whole work processes and updated their own current workflow to include the information systems processes as well as the internal policies governing the intended area workflow.

In the other site, mental health complex, workflow partially was automated, they had their own home-grown HIS imbedded in the workflow processes but still using some paper forms in parts of the processes. This is because they have not accomplished 100% full HIS implementation. Instead, they are going on different stages and phases. They still need to print the prescription on paper despite placing the orders online for both controlled and non-controlled prescriptions.

Workflow analysis forms the basis for establishing an enhanced IS processes model. Looking for current gaps and initiating fixes and resolution to it will promote the processes and increase productivity. In this study, both hospital's HIS were evaluated and reviewed during a process of observation. Both lack the exchange of patient's health information with other facilities in the same state as well as the whole region. Also working process considering technology involvement was evaluated and identified areas of improvements, particularly the ability to exchange patient's health information with other health care facilities.

5.7 **Results from the Interviews**

The responses from interview questions analyzed using thematic analysis. The particular investigation aims to identify the significant or impressive patterns from qualitative data

(interview questions), and use design themes to discuss the research, or give an opinion on the arising issue (Maguire & Delahunt, 2017). The theme of the analysis classifies into two categories of semantic and latent. The semantic theme represents the direct meaning of the data, while the latent theme analyzes the interior meaning of the responses. In the current study, the semantic theme approach is used.

The extract: These interviews aim to explore the experiences and attitudes of physicians and pharmacists using HIS in the management of opioids/controlled substances abuse/misuse issues in Saudi Arabia. This process was associated with the observation process trying to understand how they currently use the HIS and manage abuse patients. Before each conducted and recorded interview, the researcher has enough time watching and observing the process of managing regular patients and even the suspected abuse patient and how participants behave using the HIS. The responses of physicians on research questions during the interview coded in the appendix. Next are the pharmacist's feedbacks to interview questions in terms of exploring their current practice as well as their attitude and perception on the use of HIS to curb abuse issues. The total responses of 20 pharmacists in this study presented in the appendix.

Research question: What are the current processes in prescribing Opioids drugusing HIS in Saudi Arabia and what are the perceptions on the use of the current HIS among physicians and pharmacists to curb Opioids abuse issues in Saudi Arabia?

For this analysis, the six-phase framework used as followed:

a. The **first step** in the evaluation was to familiarize ourselves with the interview questions. It was done by transcribed the questions into written transcripts. The appendix

G and H showed the transcribed version of interview questions and the feedback from physicians and pharmacists shown in the appendix I and J.

b. The **second step** involved the generation of initial codes. In this step, the responses reorganize in systematic order. Each segment of the interview and feedbacks coded to seize striking points regarding the research question. The code only generates for the selected stages and not for every single line of the interview questions and feedbacks. The initials codes obtained from participants' interviews showed in the appendix K and L.

c. The **third step** involving the theme searching for the data. Themes recognize through its uniqueness. In our study, few preliminary themes formed as listed below:

- Theme: To identify the current process of prescribing Opioids drug using the HIS in Saudi Arabia (purpose of the feedback)
- ii. Theme: Physician perception of the current HIS use regarding Opioids drug abuse
- iii. Theme: Pharmacist perception of the current HIS use regarding Opioids drug abuse
- iv. Theme: To improve the monitoring of the use of opioids/controlled substances prescriptions (reasons for using feedback)
- v. Theme: To propose an enhanced mechanism to the current workflow processes of the HIS to mitigating abuse issues (how feedback used)
- vi. Theme: Suggestion from physician/pharmacist on HIS use regarding Opioids drug abuse (what researcher want from the feedback)

d. The 4th step in this analysis is the amendment of the preliminary themes from the 3rd step, which was further developed. The appendix I and J shows data associated with each theme identified and color-coded. The characteristics of themes design in this section must be coherent, distinct from each other, and work across all the interview sections. Table 5.20 revealed the main themes and sub-themes for both physicians and pharmacist's interviews. This table presents the themes relevant to the current HIS use in identifying abuse patients and curbing the issue. Besides, Table 5.21 displayed themes related to the participant's perception of the use of HIS in fighting the epidemic and their attitudes toward exchanging patient information with other external HISs to provide vital information that can help in making a proper clinical decision.

Findings for table 5.20: Total of nine main themes derived from the interview questions, such as checking prescriptions history in HIS, request patient medical background, checking frequency of visit & doctor information, drug screening test, limit the number of prescribed drugs, documentation of drugs in the HIS, dispensing drug according to policies, dispensation according to patient condition: pain/trauma/aggressive, and E-assessment at triage and physician encounter. Among the subthemes formed from the interview questions, the documentation or records took a significant role. The physician and pharmacist mainly depending on the patient's records to overcome opioids drug abuse.

Findin	igs (Themes)	Subthemes		
A.	Checking	A.1 Observation/Evaluation of patients		
	prescriptions history	A.2 Tracking of patients' previous records		
		A.3 Refer TO ER coordinator to investigate		
		A.4 Drug screening history		
		A.5 Discussion with patients		
		A.6 Acquire support		
		A.7 Manual flagging		
		A.8 Discuss with patient's family		
		A.9 Hospital policy		
B.	Request Patient	B.1 Review patients' records		
ſ	Medical Background	B.2 Follow hospital prescription policy		
		B.3 Limited narcotics prescription		
		B.4 Double checking procedures		
		B.5 Limited drug supply		
		B.6 Inform superior authority		
		B.7 Providing treatment/therapy/education		
C. Checking Frequency		C.1 Visiting date		
	of Visit & Doctor information	C.2 Patient attitude		
		C.3 Frequency of visits		
		C.4 Pain clinic reports		
		C.5 Documented Doctors notes		
D.	Drug screening test	D.1 Drug tests		
		D.2 Opioids level		
		D.3 Abuse indicators		
Е.	Limit Quantity of	E.1 Limited drug supply		
	Prescribed Drugs	E.2 Restricted narcotics prescription		
		E.3 Inform superior authority		
		E.4 Hospital policy		
		E.5 Three days' supply		

Table 5.20: Table of Themes and Sub-themes

F. Documentation of	F.1 Review documents
drugs in the HIS	F.2 Old drug orders
	F.3 Drug profile history
	F.4 Documents patient visit
	F.5 Document drugs ordered
	F.6 Documentation policies
	F.7 Report to higher authority
G. Dispensing drug	G.1 Organization policy
according to policies	G.2 Provide alternative
	G.3 Patients' status/behavior
	G.4 Legal responsibility
	G.5 Report to higher authority
	G.6 Patients act aggressively
	G.7 To support the patients
	G.8 Unable to control patients
	G.9 Admitted patients
H. Dispensation	H.1 Pain / Trauma
according to patient	H.2 Providing treatment/therapy/education
/trauma/aggressive	H.3 Physical/Psychological disorders
	H.4 Aggressive/irritating behavior
	H.5 Patient request/ demanding prescriptions
I. E- assessment at	I.1 Patients are treated on beds
triage and physician	I.2 Physicians meet patients
cheounter	I.3 At the triage area
	I.4 At the prescription counter
	I.5 Referring to medical records
	I.6 Nursing Alerts
	I.7 Others: Addiction, Dependence, Abuse, Mood changing and Behavior styles

Table 5.20: (Continued)

Findings for table 5.21: The result emphasizes on the participant's perception of the use of HIS to combat opioid abuse. There were five themes derived from questions regarding E-Prescription system preferences, identification of system abusers, awareness, and system integration. The subthemes indicated the positive opinions of the physician on the

application of the electronic system for the prescription. For the first themes of system preference, all 20 respondents agree on the E-prescription by using "yes" and "prefer". The respondents strongly supported the E-prescription by mentioning the disadvantage of paper prescriptions. The second, third, and fourth subthemes derived from main themes indicate poor agreement of the respondents regarding the HIS, as most of them used terms like no, and I do not know to answer the questions. Besides for an interrogative sentence of "What are your thoughts/expectation on a centralized interoperable (integrated) prescription drug system in Saudi Arabia to track and monitor controlled substance abuse/misuse patients, whether it could help in reducing the controlled substance abuse/misuse and their related disorders in the country?", there was theme formed as a centralized HIS for the drug prescription. Under the subthemes, the respondents mentioned the complete data recovery of patients on medicine prescription, including the private clinics to minimize drug abuse cases.

Table 5.21: Themes and Sub-themes Emphasis on Participant's Perception on theUse of HIS to Combat Opioid Abuse

Fir	ndings (Themes)	Subthemes
A.	System	Prefer e-prescription
	preferences	Includes non-electronic procedures
	(E-prescription)	Disadvantages of paper prescriptions
	(F and F)	Using e-prescription & the non-electronic system
		E-prescription restriction
		Records cannot be lost
		Ouicker
		Better prescription monitoring
В.	Identification	No
	system of abusers	Not in use
		No system
		Unavailability of such system
		Having internal system
		Connects within our hospital
		Within our own institution
		Not sure of a national database
C.	System	Do not know
	Awareness	Not aware for any similar system
		Not sure
		I know about the concept
		We have used it but in USA
		Were just implementing
		I used it a little bit
		It was not 100% computerized yet.
		I used it before, and it works well
		Never heard about it
		We do not use it.
		Never knew about this program
		Not aware of it
		I heard about it,
		but I never use it before
		Yes, I do know about the concept
		I've used it in the USA before
		Aware of the program
		Heard from colleagues
1		_

D. System	No integration			
Integration	Not connected			
0	No sharing of Information			
	No external systems Prefer integration			
	More helpful to integrate			
	Prescription exchange only			
	Need to be implemented			
	It is advantageous			
	We need a new system			
	Reduce meds errors			
	Agree to have centralized interoperable prescription system			
	Reduction of abuse issues			
	Improve our patients care			
	Better drug monitoring dispensation			
	Very helpful			
	It will be a great idea.			
	Available IT system infrastructure			
	Need to be implemented			
	Help reduce the burden of the issue			
	It will support			
E. Other themes	Centralized HIS			
represent the	System to Monitor if patient took medicine or not			
suggestions by	Focus on Complete History			
participants	Digital Technology for Education			
include	Reader card for patient			
	Monitoring other drugs			
	Policy issues/ updates			
	Tablets/Pills monitoring system			
	Alert system for abuse behavior			
	Implementation of laws & Education and awareness			
	1			

e. The **fifth step** in the thematic analysis is defining the themes. This step is done by creating themes mapping. The thematic map will illustrate the interconnection between themes and subthemes. Figure 5.16 shown the theme mapping for the current research including suggestions to improve HIS to mitigate the abuse of opioids.



Figure 5.13: Obtained Themes and Subthemes Mapping

f. The writing-up would be the final step in this analysis. Here, we discussed the qualitative analysis of the data. Since this study was not to compare between physician and pharmacy, both finding themes were grouped when necessary, considering the similarities if it exists. A total of (14) prominent themes emerged from data sets and are listed below:

Theme A: Checking prescriptions history in HIS

This theme represents one of the current practice measures taken by the physicians to control the abuse/misuse of Opioids/controlled substances as well as pharmacists when using their organizational HIS. Most of the prescriptions history of the patient was took into consideration for this theme using previous records. Out of 20 feedbacks from pharmacists, 19 of them replied positively on the patient's prescription history checking by stating "yes" to the question. Only one pharmacist commented that:

"If I found any abuse patients, we will call the narcotic manager and he or she will check whether it's to be given or not" (PH-08)

Although the pharmacist didn't directly say "yes" to the question, still his/her answer supports the theme as the statement confirming that the pharmacist would check the records to detect drug abuse among the patients. Checking prescriptions history in HIS is significant step to reduce drug abuse among patients in Saudi Arabia.

Theme B: Request Patient Medical Background

Information on patients' previous history and documented history online plays a vital role in a decision-making process to dispense Opioids drug. The subthemes under this category including review patients' records, follow hospital prescription

policy, limited narcotics prescription, double checking procedures, limited drug supply, inform superior authority, and providing treatment, therapy, or education. Among the respondents' feedbacks regarding this theme, one respondent feedback covered most of the subthemes designed for the particular theme. The respondent statement as shown below:

"There are multiple steps taken. First, the doctor will verify prescription history of the patients. Second, certain areas can prescribe medications including narcotics with the limited supply based on the location and the type of visit. Third, only certain physicians can prescribe these narcotics and usually that's the consultant. Fourth, the pharmacists will double check with the doctor if there is any discrepancy with the prescriptions. Fifth, the pharmacy will dispense only limited supply to patients presenting to acute care area including the emergency room" (MD-04)

Another respondent clearly mentioned his/her action on educating the patient by stating that "*First, we usually provide only a day supplement if the patient is in a need. Pharmacists will refer the patient to a more specialized physician if they need more supply. Second, we usually provide the patient with another option for their pain with other substances. For any abuser or patients that keep coming frequently and causing trouble in the hospital, we will write in the chart refer them to a more specialized person who can deal with them. We play the role in educating patients in terms of drugs' dependency. Sometimes, we do involve the social worker or patients 'relations if it's beyond the medical part*" (MD- 09)

Theme C: Checking Frequency of Visit & Doctor information

Frequent visits to the emergency department seeking the same drug seen among drug abuse patients. One of the respondent mentioned that "*We rely mainly on the patient's history, number of visits in the emergency and his seeking behavior*" (MD-02), while another respondent stated that "*By looking at the patients' attitude and their visiting dates and frequency*" (MD-05), he/she will prescribe the medicine. Participants evaluate the visits history and previous prescribing doctor information existing in HIS as an assessment tool before dispensing Opioids drugs. A few respondents stated that,

"We look at the patient profile; we keep track of the last time that they received medication. If we noticed repeated emergency room visits and patients tend to come only on the weekends or maybe different times a day, we keep an eyeball on the profile to see any kind of abuse. We observe patient's behavior for any possibly drugs seeking behavior" (PH-07)

"We observe the patient's symptoms by referring to the frequency of visits such as more than two times in a week, and their choice/selection of special medication" (PH-14)

Thus, the patient medical background like the number of visits, number of drug prescriptions, pain clinic reports, and behavioral changes during treatment help in studying patient's attitudes.

Theme D: Drug screening test

Opioids, as well as other controlled substances screening test was a tool to confirm overdose or abuse behaviors. Physicians and pharmacists refer to HIS to review drug test results if needed in their current practice using HIS. For this theme, three subthemes consist of drug tests, opioids level, and abuse indicators were designed. One of the physician respondents mentioned that "*First, when a patient already has admitted in his history, that he has been taking medication, and we suspect that the patients is misusing a drug, then we can run a drug test which is urine or blood test. Second, if the patients keep presenting to the ER asking for narcotics and other controlled substance*". From his/her statement we can conclude that drug screening test is important to detect opioids level in urine and blood (indicators) among the patients (MD- 18)

Theme E: Limit Quantity of Prescribed Drugs

This theme refers to the restrictions of prescribed drugs to mitigate the opioids abuse among patients. Under this theme, few subthemes listed as followed: limited drug supply, restricted narcotics prescription, inform superior authority, hospital policy, and three days' supply. There was a feedback from respondent mentioned that "*The policy as strictly restrict us to prescription of opioids for just a day. If the patient needs for any ongoing supply of opioids, then the patient must go to the clinic setting. The pharmacists will strictly follow our electronic system orders. If they see any deviations from the hospital policies, they will immediately contact the prescribing physicians*" (MD-16). From the respondent statement, we can summarize that drug dispensation limitation for patients depend on the hospital policy and its tracking system feedback.

Theme F: Documentation of drugs in the HIS

A documented drug list in the used HIS can retrieve for 15 years back. It includes drugs used by patients from other hospitals. Every drug dispensed should record online to go to pharmacy through the organizational HIS. The documentation of drug use among patients from both government and private clinic need to accordance in the HIS system to monitor the patient's drug intake. A respondent feedback regarding above theme emphasized the importance of the documentation on drug in HIS, which can detect the overlapping of the drug distribution among patients. The statement as stated below:

"Yes. First, I'll check the history of the patients and review the last prescription if there's duplication dispense, or the patient has more medication. I'll stop the prescription and talk with patient and talk with the physician to know why the physician dispense the prescription" (PH-12)

Theme G: Dispensing drug according to policies

This theme refers to the responses of the physicians and pharmacists on how to control drug abuse in their current HIS. Organizational policies govern the dispensation process in the HIS to curb abuse and overdose concerns. The physician and pharmacist mainly dependent on their organization policies on drug control among patients. One of the respondents clearly mentioned the importance of organization policy in distributing drugs.

"We trying to minimize this. In our pharmacy, based on the organization policy, the patients will be given a one-day prescription only. For any patients that always shown frequently and known drug abuse, he/she can be reported to higher administration or chairman" (MD-18)

Besides, the organization policy also provides alternative to physician and pharmacist to referred patients for respective authorities depending on their aggressive behavior. A respondent mentioned the condition of patients, which need assistance of other authorities as stated below: "To report to administration, get possible potential multidisciplinary team support, report to patient relation, social services, pain services. For any patients' aggressive cases, we will report to higher authority such as police when the patients are not able to suppress this kind of behavior" (MD-18)

Theme H: Dispensation according to patient condition: pain/trauma/aggressive

Physicians and pharmacists can override rules in the current HIS to prescribe prescription to patients when they need it and suffer from pain or trauma even if the patients known as drug abuse patients. Also, sometimes this practice done to avoid patient aggressiveness and demands. This is associated with continuous education on the side effects of narcotics. Several feedbacks shown that the patients came for drug shopping in the hospitals.

"Patients requesting some medication such as narcotics. People coming with the same complaint and the same excuses. Obviously, a frequent user or usually people who come to ER and sometimes they are in withdrawal and that create some behavioral issue once a while. There are some chronic pain people who usually comes they are much more of bargaining and shopping for narcotics".

"Usually those patients are demanding, agitated, and they are in pain" (MD-09)

"We generally only give one-day supply of narcotics. If they need anything stronger and longer, than they must go on doctors. Symptoms we see are frequent visits, over exaggeration of symptoms, and sort of non-physiologic pain, non-cancer pain, nonboney pain. We also see maladaptive behavior, specific request that is violent, shouting, and very demanding. They come in intoxicated on the drug that they are using" (MD-20)
Theme I: E-assessment at triage and physician encounter

Electronic assessment and online documentation for signs of abuse could occur in the triage screening area done by nurses initially, or the other option offered was to do it at the doctor's exam room when the doctor attends to the patient for an exam. Both ways were used by the organization and findings are documented in their local HIS. The opioid/controlled substances related disorders among patients first detected by nurses at triage. But the nurses can't send the information to physician. This was supported by the respondent feedback as follow:

"Both at the triage and at the physicians' encounter. The nurses at the triage were trained ones and they will follow the protocols needed to screen patients. For instance, they will ask the patients and look at the patients' behavioral presentation and changes. However, in the current system, the triage nurses can't send any indication about the patients to the physicians" (MD-04)

Thus, E-assessment play a vital role to keep records on the drug abuse patients.

Theme J: System preferences (E-prescription)

E-prescription system was preferred compared to paper prescription. It is quicker, safe, cannot be lost, and free of errors, although only controlled prescriptions require printing to be signed by patients for security and tracking issues. All physicians interviewed were shown a positive attitude towards the e-prescription system as they think paper prescriptions can be misuse, while the system will be more specific on the patient's drug needs. All the respondents think that keeping online track records much safer and easy to trace compared to paper prescriptions. One respondent gave feedback by stating "*I prefer using e-prescription system*. *The main advantageous, it's very easy to monitor the history of prescription. It's*

centrally available to all the physicians within the same facility. This will minimize the rewriting of same medications" (MD-17).

Another feedback pointed that "*I prefer e-prescription. Because, after the order has* gone through, then the medication will be administered to the patient. With paper prescription from my experience, sometimes the order has been given verbally, medication has been administered and there's no paper trail thereafter. And those leads to miscorrelation which stock-taking takes place and there's been incidences where controlled substances have gone missing" (MD-16) Thus, overall respondents prefer using e-prescription to keep the patients' records well controlled.

Theme K: Identification system of abusers

This theme represents the lack of identifying drug abuse patients on arrival. No unique tool to flag those types of patients to alert staff. They only use their internal system to find any identifying indicator for abuse suspicion. Based on the physician's suspicious only, the patients were monitored. Yet in certain cases, it may be overlooked by doctors due to the number of patients and different periods of the treatment visiting of patients. Out of 20 respondents, half of the respondents said "no" to question related to above theme, while another half of them emphasized that their hospital has own system, which is not shared with other hospitals in Saudi Arabia. Example of the feedbacks of both parties' respondents as given below:

"We only using the system that can only check the internal records in the hospitals only. In fact, if the records are in the outpatient system, we cannot check if the patient is taking another prescription from the in-patient system or from other clinics in the hospital" (PH-06) "The answer we didn't have any system to identify, or track and monitoring in Saudi Arabia" (PH-14)

Theme L: System Awareness

This theme represents the level of awareness of physicians and pharmacists on the existence of a system that can track drug abuse patients. Responses vary, but the majority were not aware. Few had the experience to work outside Saudi Arabia, where they either witnessed it or used for a short time. Few respondents stated they had heard about it but never used it with the country locally. Responses in this theme acknowledge the existence of only an internal system that used to review and track patient medication profiles within the same HIS. The feedback from respondent that not aware of the system stated as follow,

"I'm not aware of it and I've been never ever use it before" (PH-02).

The respondent who has experience outside from Saudi Arabia replied in the manner like "Yes, I know about the concept since when I was living Massachusetts in Unites States, we have that monitoring program in our state. We were just implementing 2 ¹/₂ years ago & I used it a little bit, but it was still in the early stages of the monitoring, and it was not 100% computerized yet. It was still in putting data manually and not 100% electronic" (PH-07).

Another response towards the theme as followed, "*I have heard but never use it*" (PH-03). Thus, the theme reminds the necessity of the HIS between hospitals in Saudi Arabia to mitigate opioids abuse among patients.

Theme M: System Integration

Organizational HIS is not integrated with any other external HIS to exchange patient-related information including medication profiles. Under this theme, participants prefer to integrate with external HIS as they view it as a helpful tool to prescribe medicine to patients, by avoiding medical errors. The respondents also think that the HIS is a helpful tool to exchange patient information and interested in having it. Multiple benefits achieved when an interoperable tracking system implemented like improve patients care and help to reduce drug abuse cases among patients.

One of the respondents well said on this matter as, "Yes, I prefer integration. It should involve not only controlled medications but other prescriptions as well, so that there is no duplication of medication. This program helps to get rid of duplication of services, duplication of investigation, duplication of diagnosis, uniformity of patients' care which could be crossed not only hospitals across the city, across cities and across the country" (MD-04).

Theme N: Other suggestions

The themes represent the suggestions stated by participants as an additional wish list like centralized HIS, system to monitor if patient took medicine or not, focus on complete history, digital technology for education, reader card for patient, include other drugs distribution, and policy issues.

The themes and their relevant sub-themes further described in following subchapter.

5.7.1. Details of the relevant themes and sub-themes

a. Checking prescriptions history in HIS

This theme represents several measures taken by the physicians and pharmacists to control and track the abuse or misuse of Opioids or controlled substances. In terms of the current practice using the HIS, steps taken to identify opioids and other controlled substances are supported by the organizational policies that consider when examining patients and reviewing patient charts.

The physicians closely observed the patients for symptoms of craving, psychotic disorder, and signs of any physical injury or stress. The steps as reported by the physicians are listed thus: Observation/Evaluation of patients, tracking of patients' previous records, refer to ER coordinator to investigate, drug screening, discussion with patients, acquire support, manual flagging, discuss with patient's family, and follow hospital policy. It depends on physicians to physicians whether they recognize such patients based on their clinical judgment or suspicion and recognition. The physician suspicion based on the documentation, where it showed the patient history on prescription details and the number of patients is visiting.

b. Request Patient Medical Background

These themes represent several measures that have been adopted by the hospitals and the clinics to tackle and avoid substance abuse or misuse. The most significant step is to track down patient medical records. In this regard, a respondent mentioned- *"First, I look through the electronic medical records to see recent prescriptions. Second, by looking at the patients' way of demanding and asking their medications. As for the mental disorders patients who are at high risk, or patients with a history of substance abuse, or the ones with addictive behavior or having frequent prescriptions, they will flag in the hospital*

system" (PH-04). The physicians try to interact and discuss with the patients so that they can get an idea of whether the individual is an abuser or misuser. Measures, as reported by the physicians in tackling and avoiding substance abuse/misuse, involve tracking patient records; following hospital prescription policy; limiting narcotics prescription; double-checking procedures; limited drug supply; informing superior authority; providing treatment/therapy/education.

c. Checking Frequency of Visit & Doctor Information

This theme represents several characteristic traits that an abuser/misuser possesses, thus helping the physicians to distinguish them among other patients. Many patients behave aggressively and tent to be violent. A respondent said- "…certain areas can prescribe medications including narcotics with the limited supply based on the location and the type of visit. Also, only a few physicians can prescribe these narcotics, and usually, that is the consultant" (MD-04). The pharmacists dispensed prescribed a controlled substance to a controlled substance abuse/misuse patient based on the medical history of the patient. They enquired about the prescription and reviewed their frequency of visits and verified any irregularity in the medicine uptake.

d. Drug screening test

This theme represents Opioids as well as other controlled substances screening tests as a tool to confirm overdose or abuse behaviors. It is one among multiple actions that can be taken when a suspicious behavior of a patient exists. This is to confirm diagnosis as part of the current practice to detect Opioids abuse patients and is applied even for other drugs if needed. One of the participants stated, "*We usually require drug screening, such as the abuse of vitamin, or other than opioid.*" (MD-18).

e. Limit Quantity of Prescribed Drugs

This theme is presenting one of the guidelines and policies currently used in controlling opioids abuse. These policies and practices limit the orders and dispensing of opioids and other controlled substances to a max of three days only. One respondent stated that "*As per the guidelines of the hospital, the ER physicians are prescribing a maximum of three days of narcotics pain medication to limit the number of prescriptions*" (MD-01), while another one said, "*We have a very restricted prescription limits for narcotics.*" (MD-03)

f. Documentation of drugs in the HIS

This theme represents the importance of documenting all relevant information on suspected abuse patients. These including finding, assessment, and impression. It will help other physicians to manage the case well if the patient comes for another visit. One respondent said- *"I usually document the patients visit in the system."* (MD-06). Documenting finding and history for future review is driven by policies of the organization and current HIS support the online documentation by all care providers.

g. Dispensing drug according to policies

Dispensing drugs in the HIS is governed by multiple authority' policies such as the ministry of health, ministry of interior, and the hospital management policies. The policies emphasize on dispensing the opioids for a limited period not exceeding three days in an emergency, double-checking orders, compare previous orders to current and even reporting case to higher authority if a suspect on patient behavior exists. Also, policies assure the importance of educating the patient on using such substances.

h. Dispensation according to patient condition: pain, trauma, or aggressive

Policies also give the physician some space to manage the case according to the patient condition, and behavior. Patients might be in real pain or trauma regardless of their abuse issues; so, management will be according to patient needs. Also, aggressiveness behavior, psychological disorders, and seeking attitude need to be well assessed and managed by physicians as well as pharmacists to avoid harming staff or himself. In some conditions, patients admitted to the hospital for better management and to provide a medical intervention to support patients get rid of the abuse problems.

i. Assessment at triage and physician encounter

This theme refers to the methods physicians use to screen patients before giving any prescription, thus avoiding the possible risk of controlled substance abuse/misuse. According to physicians, patients should check thoroughly before prescribed with any drugs. This can achieve by asking detailed questions to the patients related to their medical condition. The methods can be initiated either by a nurse or physician to start the early assessment. The options include screening areas such as: treating patients on beds, physicians meeting the patients, and screen them at the triage area; at the prescription counter, referring to patients' medical records, amongst others. This practice can help staff detect early symptoms or indicators of substance abuse by the screening staff, which can be a red flag for the prescribing physician to consider.

j. System Preference, E-prescription

This theme refers to the responses of the physicians and pharmacists regarding the implementation and use of the E-prescription tool in their HIS. E-prescriptions have been recently in use in both sites. However, to control the abuse or misuse of controlled substances, e-prescriptions for the same are required to be signed by the concerned

physicians to become valid. Responses from the physicians include the use of both eprescription & the non-electronic system and the restriction of the E-prescription system. Participants agreed that e-prescription is a quick and safe tool when prescribing Opioids and other drugs and cannot be lost as a document. Compared to paper prescription, eprescription was preferred mostly by all participants due to its numerous advantageous benefits and the ease of use when retrieving previous drug orders for suspected abuse patients.

k. Identification system for abusers

This theme represents the responses of the physicians and pharmacists with regards to which kind of technology is used to identify, track, and monitor controlled substance abuse or misuse in Saudi Arabia. From the responses of the participant, it noted that in Saudi Arabia, no system exists to exchange patient information therefore, there is no way to identify abuse patients and alert staff about their history. System to identify abuse patients exist within their organizational HIS but it is not a standalone system, instead, it represents some tools exist in the current HIS to help users identify suspected Opioids abuse within only the organization HIS is used in. Some participants denied awareness of having a national database that can share patient information with their organization as one of the participants stated, "*Right now, we are monitoring within our institution. It is not a national database to the best of my knowledge*" (PH-07)

I. System awareness

The theme explains the level of awareness by some participants on the existence of a tracking system to monitor opioids abuse patients. Participants were not sure if such a system exists either in their organization or on a national level. Such a theme assures that system does not exist since they are not using any tool to identify or detect abuse patients.

This theme also represents some of the responses to having or using a prescription drug monitoring system. They stated that they never hear about such a system to monitor the abused patient nor used it in any facility they had worked for so far. This indicates that such a process does not exist in the country. One participant said, "*I didn't hear about the system & we don't use it here*" (PH-01).

This theme and relevant sub-themes represent the participant's experience of a prescription drug monitoring system wherever they had worked. Very few pharmacists said that they were aware of the concept of prescription drug monitoring program (PDMP) implemented in the USA, France, and Australia for monitoring and tracking prescription drug abuse and about its possible use in managing prescription drug abuse /misuse, but never used personally. One of the pharmacists said- "I've used it in the USA before" (PH-10). Another pharmacist replied- "I know about the concept since when I was living Massachusetts in the United States, we have that monitoring program in our state" (PH-07), while most of the physicians were aware of the prescription drug monitoring programs (PDMP) concept. Few mentioned that they have used the program or other similar ones but at a very basic level. A respondent stated- "I've heard about it since I worked in Kentucky. We had over there in the US and Ohio, where one can log on the central databank and we can look at all the narcotics prescriptions patients used or obtained from different providers" (MD-01). The physicians who have used the program revealed their satisfaction related to the program and it was evident from one of the responses that mentioned- "I'm aware of the program. Heard from my colleagues whom many use it and it's fantastic" (MD-16).

Some heard about it from colleagues but never had the chance to work on such a system particularly in the kingdom of Saudi Arabia. These statements assure that there is no system concerned with monitoring Opioids abuse patients in the country in general, which magnifies the issue to manage.

m. System Integration

This theme represents the responses of the physicians and pharmacists with regards to if their organization integrated with the HIS of other external organizations. Majority of the physicians mentioned that their organization was not integrated with other external organization HIS and that they were willing and wishing to integrate with other systems.

Some other sub-themes are listed in Table 5.20 refer to the perceptions of the physicians with regards to the application of a centralized, interoperable, and integrated drug system prescription workflow in Saudi Arabia. Most of the physicians viewed interoperable (integrated) prescription drug system as a good step that would facilitate access to a complete set of patient information. Further, when the interoperable workflow process is built, it will be helpful to avoid Opioid and other controlled drug abuse in the country and thereby will brings a positive impact in controlling the abused controlled substances. A respondent stated that "*It will be a good idea if this is applying in our hospital*" (MD12).

The main theme and other specific sub-theme represent the positive attitudes both participants' groups have on exchanging patient-relevant information and medication profile. They believe it is a great benefit to adopt such an improved integrated HIS workflow and that its benefits extend not only to curb abuse issues but to others such as reducing medication errors and improving the whole patient care services. They all are agreed with its importance, and it would be a helpful tool in controlling Opioids abuse issues if built and implemented within their organization and other health care facilities.

One of the repetitive responses stated that "It will improve our patients' care as time being, we just can track the medication patients taking from our organization. We did not know whether the patient took the medication from another hospital or in any other organization. It would be helpful to reduce the abuse of the medication" (PH-04. Finally, there have been sub-themes that also assures the positive perception of the participant on the helpfulness of having an interoperable monitoring information system integrated with their local HIS. Since they have advanced IT infrastructure, the adoption of such a workflow process to exchange patient information with other external HIS would be implementable to reduce the burden of the existing abuse issues.

n. Other suggestions

By the end of the interview, participants were asked if they have some other information or suggestions to research concerning their wish list of what to have or want to use in terms of curbing abuse issues or improving their patient care in general. The themes in the table 5.21 represent the other suggestions stated by participants as an additional wish list like using technology for education on abuse side effects and addiction, to include other drugs to be tracked and emphasize policies driving this trend. The main themes for suggestions proposed by participants as extra or alternative tools to help curb the abuse issue are listed in the table.

5.8 HIS Proposed Workflow Processes

5.8.1 **Proposed HIS workflow processes**

This part of the finding section is built to meet an important objective of the study, which in turn respond to the main goal to fix the problem of lacking HIE to curb and mitigate the abuse issues. The objective to meet is no 3 of study objectives.

Objective 3: To propose an interoperable, integrated HIS workflow processes capable of mitigating abuse issues in Saudi Arabia.

Therefore, and based on the finding from observation conducted in both sites for understanding the current practice with the organization's HIS aligned with the findings from interviews, researcher was able to identify the gap that may contribute to the poor management of Opioids abuse patients. This gap may lead to an increase of the number of addiction patients since no complete history of patient is available for clinical decision makers. Gap was fixed through the implementation of interoperability so HIE process can take place and care providers may have the chance to overview patient medication history retrieved from other HIS's from different facilities to take a proper action towards their patients' needs in a safe environment. The below diagram in figure 5.14 presents the proposed HIS workflow processes including the interoperability processes so it involves both physician and pharmacist workflow and what information is available in hands that should help them in producing a free harm decision. One more thing unique in this process is that health information retrieved from external HIS will be pushed into the organizational HIS with the same patient chart, so the doctor and pharmacist do not waste time looking for the information and it is viewed by all of them within the same window. More details on the same workflow will be detailed in the next sections to clarify how this process will work and be more efficient for clinicians to safe patient and protect their practice.



Figure 5.14: Proposed HIS Workflow Processes

The next diagram is another form of the same proposed workflow process and shows the new proposed workflow processes when incorporated within the patient tour or visit to a hospital and how smoothly process is injected in multiple phases to make sure it gets the attention of the users, also shows how it will work by pharmacist and physicians and even any other clinical user interested to know about the case.

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Figure 5.15: Proposed Workflow Process within Patient Visit Activity

5.8.2 Proposed HIS workflow processes details and functions

It is very important to have any information system a friendly used when designing and building it. Considering users' capabilities and wish list ease the use and increase system acceptance. In this study, we focused on fixing gaps identified and particularly the ones involving user interface. This process of the intended workflow model aims to enhance the processes of tracking the drug abuse patients and monitor the dispensation patterns of the controlled substances in a step to curb the issues of abuse and misuse of opioids.

The enhanced processes start on patients' arrival to the emergency seeking the management of his/her complaint but with the intention of getting the opioids or any other classified drug.

This processes model consists of multiple phases and functions. The first step starts within the current organization HIS. When patients are registered in the system and upon completing the registration process, a request message is sent to all synched health organization information systems requesting the dispensation history for opioids for this patient. This message goes through a messaging bus that organize the routing and flow of the messages. If other facilities have a dispensing history for that patient, a reply message is sent back to the requesting organization with the history. If for any reason no reply is returned, processes have an alternative path to the centralized data base center that has all dispensation history of the opioids as well as other classified drugs when indicated. The received message is then pushed into the local HIS patient chart section to be viewable by care provider starting from the screening area so they can alert the physician as an early alarm, and then doctor can view it before going to the patient so he/she can have a clue of what the patient had been given in the other facilities if done. This information will help the doctor to plan manage the treatment intended well. This will not be the scenario with every patient coming in because drug abuse patient is a small number compared to the total patient visiting the hospital. So, the process of exchange the health information will be at minimal level in term of total patient requesting the same message.

The below structure details the process of interoperability among different facilities to get the request information for a specific type of patient. This structure will be helpful when the workflow processes proposed is to be implemented to facilitate the understanding of how exchanging the information will take place.



Figure 5.16: proposed HIS Workflow Processes Model System Architecture

System architectures consist of three basic phases. Each phase is located on different site and interfaced through a high standard interface engine such as HL7 or its latest version FHIR. FHIR had been discussed in more details above in literature review (chapter two), but other tools can do the job according to each organization capabilities and infrastructure. In phase one, request of information is initiated by hospitals attended by patients, message to collect relevant information on patients is sent. Phase two involve processing the request through the interface engine that will encrypt request message and decrypt reply accordingly. This phase contains the most important steps of the processes since data will be collected and processed to respond to the type of request using HIE protocols and policies. It also contains the data base layer that will work as an alternative respondent if the organization in phase three fails to respond. Lastly, phase three contains the respondent's organizations that should reply to the initial request initiated in phase one. This structure requires the cooperation and strong commitment of the decision makers to be functional. It requires unifying relevant tables, standardizing terminology and applying the same security and confidentiality standards and policies to work well and reach optimal organizational goals of interoperability and participate in conducting clinical work in a safe environment.

In summary, and in the previous sections, observation data analysis and analysis from interviews with the participants shows that both physicians and pharmacists are suffering from the lack of exchangeable patient's health information. Providing physicians and pharmacists with patient's medication profile from other health care facilities will promote and grant a proper clinical decision-making process. Many participants agreed that developing an interoperable information system to help in exchanging patient's medication profile would be a great step in curbing opioids abuse / misuse issues in their region. They also emphasized on integrating this information with their organization HIS to ease the access and speed the process of a decision making. All these aspects will help

in providing the care to suspected patients in a safe environment and would eliminate the risk of increasing drug dependencies.

The proposed HIS workflow processes had incorporated all the participants' positive inputs and concerns of interoperability issues including the integration process within the organization HIS.

5.9 Modelling Workflow in Healthcare Sector

This section shows how the HIS workflow process model was evaluated and conducted to come up clearly with the proposed workflow processes from different perspectives.

Modelling of workflow and business processes in the healthcare systems is always a challenge, and models and systems become more complex and challenging to users. An important consideration for modelers is the usability of the model among users. In addition, the model should contain sufficient details at all levels to fulfill the aim of the modelling. Furthermore, depending on the requirements of the organization, privacy, flexibility, extensibility, completeness and system requirements, the model must be cable of handling exception handling features and security (Rad, Benyoucef, & Kuziemsky, 2009). Thus, modelling should take into consideration several factors including:

5.9.1 **Process complexity**

Healthcare is comprised of multiple complex processes since provision of care frequently involves multiple providers and scenarios that employ different levels of knowledge, located in different geographical and physical locations. Measures of complexity of such processes can be understood in terms of the units involved in the process, the number of collaborating parts and the number of tasks that must be executed (Gruhn & Laue, 2006).

For example, an organization might comprise of 20 units and more than 60 transactions, of which each transaction contains a specific message type. Furthermore, individual units such as a radiology unit will have to collaborate with other departments such as the nursing department and such collaboration increase the complexity of each transaction or task. While modelling languages have been shown to consider collaboration as important, there is sufficient evidence that collaboration can be difficult in the healthcare sector. Existing models of collaboration are far from maturity and are currently inadequate to meet the needs of healthcare organization (Gruhn & Laue, 2006).

5.9.2 Security and privacy

Collaboration increases the risk of issues related to privacy and security of patients. These issues tend to arise during development and implementation phase of the model. This is especially important as healthcare processes involves multiple players including insurance, billing companies and other players who need to access patient information (Yang & Niu, 2015). Therefore, a model that utilizes information technology must contain sufficient security features and contain safeguards on the protection of health information during transmission. Privacy and security features are essentially important when the model involves collection and transmission of information through web services where different stakeholders have an opportunity to access health information anywhere on the network. Thus, the process models should have the ability to define privacy details essential to the protection of protected health information and security details that limit the access to patient information to those allowed such as physicians and pharmacist in this study (Plesk & Wilson, 2001). These all need to be considered and applied when such a workflow process to be implemented.

5.9.3 Interoperability and integration

Healthcare processes require proper integration and interoperability to be more efficient. The key reason is that a typical healthcare information system is connected to multiple HIS's that are optimized for different medical facilities and. Lenz and Reichert (2007) notes that there is a need to consolidate data from different HIS as it allows for interchange of information from different departments. Monteiro (2003) contends that failure to coordinate and integrate work processes leads to redundancies, ambiguity, and secondary administrative overhead. Namli and Dogac (2010) further notes that integration is essential for information technology-based support for processes in the healthcare sector. Interoperability ensures that data integration and processes support collaboration between multiple health care facilities HIS to communicate. In the business process management, interoperability allows for collaboration. According to Khan *et al.*, (2013), the purpose of interoperability is to allow HIS's within a healthcare facility to communicate and exchange data efficiently and effectively. To achieve interoperability, the systems used in modelling workflow must be interoperable with other systems employed in the management of healthcare processes.

5.9.4 Context

To overcome contextual issues associated with workflow and business process management (BPM) in the healthcare sector, a model must have sufficient details based on the context of the healthcare organization. Context is defined by Dey (2001) as information on individual characteristics of the situation of an organization that is relevant to the interaction between the application and the user, including the application and the user themselves. Born, Kirchner, and Muller (2009) contends that a context is the environment in which the healthcare process is executed. Technology cannot structure the activities of the individual or the organization and must be adopted to fit the specific needs of a context. In BPM context can be categorized depending on information that is treated and observed. Several categories exist including system capacity context, roles support context and business process context. Saidani, Rolland, and Nurcan (2015) recommends that context modelling should be a part of workflow modelling as it allows for proper structuring and description of contextual situation of a task session, as well as the interaction between service and the user.

5.9.5 User understandability

Modelling healthcare processes as part of BPM is inherently complex. While the sole purpose of modelling is to describe and document systems, models should be designed in a manner that enhances the understanding of the system by either stakeholders or users of the system. According to Rad *et al.*, (2009) healthcare process modelling is far from mature or optimal and thus that aim of redesigning a process is to remove non-valueadded tasks, reduce cycle time and reform inefficiencies within the healthcare processes. One of the key questions is that if a model is not sufficient to provide a clear picture of the healthcare processes to stakeholders, then how can inefficiencies in the system be identified and corrected. Furthermore, models can be used to train new employees on the working of the organization and execution of business processes. Training healthcare professionals using process model is particularly important when the healthcare organization is comprised of a larger number of employees and departments. Thus, an effective and efficient process model design must consider whether the model represents each construct in the right manner to ensure that stakeholders and users. (Turetken & Demirors, 2018)

According to Turetken and Demirors (2018) understandability of a process model is influenced by task effectiveness of the model, task efficiency, mental effort, or cognitive

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load of users. Thus, the impression, involvements and inputs of users in such study would ease the acceptance of the workflow process when implemented.

5.9.6 Flexibility

The failure of traditional BPM modelling approaches can be attributed to lack of flexibility (Aalst & Jablonski, 2000). Thus, when modelling and applying workflow management, there is a need to enhance flexibility given the wide range of different services that are offered by healthcare organizations (Mans, Workflow Support for the Healthcare Domain, 2011). Flexibility on modelling can be achieved in three ways, flexibility by design, flexibility by deviation, flexibility by under specification, and flexibility by change. Flexibility by design is achieved in the initial model through the incorporation of alternative pathways within the process model, which allows the system to select the most appropriate execution path. Such flexibility is possible through the use of constraints, rule-based invariants, process grammar, fuzzy logic and temporal logic expressions (Mans, Workflow Support for the Healthcare Domain, 2011).

The other type of flexibility is by design. It is achieved when execution of a task can deviate at runtime from the prescribed process without altering the process model. Such deviation only involves changes in sequence of tasks and not deviations in the process model or the tasks within the process model. Flexibility can also be achieved through under specification. This is referred to the ability to execute an incomplete process model, or one that does not have sufficient information for completion. It can be achieved in two ways, one by including placeholders in the model (Mans, Workflow Support for the Healthcare Domain, 2011). Placeholders are nodes that mark underspecified areas and whose content is provided when the task is being executed. The other approach is where the model is left incomplete through omission of tasks and conditions. Last and importantly, flexibility can be achieved through change. Such flexibility arises when the

process model can be modified during runtime, such that new processes or instances are integrated into the new model. Flexibility by change is particularly complex and highly challenging (*van der* Aalst & Jablonski, 2000).

5.10 Workflow Process Modelling Languages

A process modelling language plays key role in the modelling of processes. There are a large number of languages that can be used to design a process model, such as Web Services Choreography Description Language (WS-CDL), Business Process Modelling Notation (BPMN), Electronic Business using eXtensive Markup Language (ebXML), and Process Definition Language (PDL) among others. However, the complexity of these systems and diversity in characteristics of business process makes it difficult to choose the most suitable modelling language for complain domains such as the healthcare sector. Rad *et al.* (2009) argues that there are many frameworks for determining the right language for process modelling. However, most of the models are limited in that they do not incorporate constructs that allow for inter and intra team collaboration, complexity and number of disciplines, flexibility of care processes, and dynamic nature of care delivery.

Thus, when developing a process model, focus is on a language that cannot not only allow the modeler to represent the model graphically, but also one that takes into consideration of the complex nature of provision of healthcare. Rad *et al.* (2009) developed a model for evaluating process modelling languages that will be used in this paper to identify the most appropriate language for developing process models. According to Rad *et al.* (2009) several factors should be considered, including privacy, security, pattern presentation, ontological completeness, extendibility, notations modularity, level of detail and flexibility. Security and privacy are essential in modelling as some of the process require protected patient information such as medical diagnosis. Thus, a language should be able to take into consideration the protection of such information using an interface that keeps the process private.

The other key consideration is pattern representation. A modelling language ought to have the capability of representing flow patterns, communication data flow in an understandable manner. If the language can sufficiently present patterns in an understandable manner, then the emerging model will be understandable to users and stakeholders, a key requirement for proper implementation of BPM in the healthcare sector. Pattern representation is important in the healthcare sector as it decreases ambiguities in the process model and allows different managerial and clinical actors to understand the system (Rebuge & Ferreira, 2012).

Modelling languages can be categorized based on rule-based languages, into graph-based languages and notations. Textual and language notations are evaluated by the way they follow specific standards such as colors and element size for graphical notations. Ease of use of a modelling language can be achieved through uniformity (use of same notations for specific meanings) and formality (use of accepted notations for language concepts). Notations or series of written symbols improve understandability of a process model and is therefore an important factor in the selection of a modelling language. Since provision of care involves multiple actors with differing levels of expertise and knowledge, use of standard and coherent symbols and notations improves the process model for all actors (Rad, Benyocef, & Kuziemsky, 2009).

The other key factor to consider in selecting of modeling languages is modularity. Modularity is measured by evaluating the ability of the language to support abstraction of both sub processes and processes. Abstraction involves protection of underlying layers of a process and hence improves the understandability for those actors that are not experts in modelling. Process models improve when some of the unimportant data such as logarithms that make up the language are hidden from the non-developer actors. Design of languages in a modular manner reduces complexity of the emerging model and allows developers to hide non-relevant information. This is particularly important in the healthcare field as different actors have different levels of expertise and understanding (Rebuge & Ferreira, 2012).

Level of detail is also another key consideration when choosing a modelling language. Process models should be optimized for modelling different processes and for different purposes. Detailed presentation of processes improves the understanding of the modeler and the end user who uses the process model for training or evaluating the business process. A key factor to consider in the context of level of detail is flexibility. A modelling language should be flexible enough to allow for detailed modelling of systems for the IT team, and general modelling for mangers and other stakeholders who require a general view of the model or process. Such stakeholders are concerned with general view and not the implementation details. Last and importantly, a good modelling language should be able to handle exceptions. Exception handling allows for high levels of flexibility and adaptability of models (Rad, Benyocef, & Kuziemsky, 2009). In the healthcare sector, there are many exceptions that arise in various forms. For example, in the emergency, care providers may not follow routine workflows and procedures. If a modelling language is not able to handle such exceptions, then the caregivers may find it difficult to follow the process model.

While modelling business process into healthcare systems is becoming a reality, modelling of workflow processes to include HIS's remains a key concern for healthcare organizations. HIS comprise of a set of ICTs (information and communications technology) based solutions, information flow, and organizational structures that support secondary and core processes within a care facility. The aim of HIS is to support secondary care by interconnecting systems that manage a large amount of multimedia, codded, structured and narrative data. Graphical models of workflow and business process can be used in developing information systems by integrating information flow within the models. One of the most developed approach to integrating workflow systems into HIS is the MATH approach developed by Butler *et al.* (2014). The approach capitalizes on business modelling tools for workflow and Unified Modelling Language generally used to model HIT information structures. A core capability of the approach is to capture existing workflow and process models, as well as information systems in manner that would allow the care processes to be improved through information technology. The key reason for the development of the approach is that there is little information on the integration of information systems into process models.

According to Butler *et al.*, (2014), the first step of the process is an observation study to discover the model and understand the how care is provided within a facility. This first process allows the individual modelling process to determine the best workflows and problems associated with the workflow. The second step is to analyze how HIT can improve the problem areas. In the current study, the main issue is opioid abuse and misuse. Step two in the process allows identify areas where information does not match tasks, or its integration cannot to be done manually. Step there of the process involves analyzing information needed to support each workflow. These steps are essential in integrating information technology systems to workflow models to improve care processes using information technology. The work of Butler *et al.* (2014) has been extended by Berry *et al.* (2016) who illustrated that workflow and process models can be expanded to include information flow processes using UML (Unified Modeling Language). Thus, the emerging model allows healthcare institutions to benefit from workflow processes, while integrating HIS's to improve efficiency and effectiveness of the work models. In this study (UML) approach was adopted and web software called

Lucid chart application was used to produce the proposed interoperable workflow process model.

5.11 Workflow Process Validation

5.11.1 Introduction

A workflow model refers to a sequence of tasks following each other in each organization. These tasks are customarily undertaken based on specific rules defined on the users for the execution of business processes. A design life cycle has various stages, which include business requirements, specification, verification, validation, optimization, and deployment & monitoring. Workflow process models are designed based needs of the organizations. In this case, the healthcare industry will be considered, and aspects such as data of patients, costs, follow-ups, and organizational operations will be regarded as the needs of the workflow process model. To ensure that the workflow process functions well, the process of validation remains paramount.

The essence of designing a workflow process model for an organization is to make work easy and increase the efficiency of processes by providing accurate data. A useful model would always help an organization achieve its goals (Song *et al.*, 2006). This understanding brings us to the aspect of validation. Validation is one of the critical steps that is done with the utmost caution to ensure that all the data provided for a given healthcare organization is accurate, complete, and efficient (Leyla & MacCaull, 2011). Validation can only be done after verification of the needs of the organization. This comes after a process design has been specified by a language and confirmation of verifiability for structural precision. Verification of the requirements assures the experts that validation will take place only on the verified elements. One thing that remains dominant in the validation process is ascertaining whether all the data needed is present. However, it should be noted that validation is not the ultimate solution for the overall functionality of the workflow process model (Chen & Yang, 2008). It functions by offering various tools that crosscheck the processes and attributes of multiple activities. This helps in identifying conflicting and redundant elements.

5.11.2 Validation of new workflow processes

Validation would happen on an existing workflow model or a new one. The design process of a workflow involves collecting all the needs of an organization before starting. If a new workflow is designed, then the standard procedure of the design process will be followed before validation is done (Sadiq *et al.*, 2004). On the other hand, introducing changes to the workflow process at a certain point means that the workflow must be aligned with the new changes before validation. Consider the following chart indicating the normal process of a workflow process model. It is also called the process life cycle.



Figure 5.17: Process Life Cycle

The figure indicates that validation would only occur when verification is already done and before optimization. The above process life cycle is a typical flow of stages in workflow, and that means for a new workflow validation would be done as the fourth step (Peled & Tsay, 2005). On the other hand, when new changes are brought in an already existing workflow, the changes must be aligned first (Sadiq *et al.*, 2004). The process of alignment involves comparing with the changes with the business requirements, checking on the specifications, and then verifying them (Eck, Gordijn, & Wieringa, 2009). Once this is done, the validation will take place. Therefore, it is agreeable that the alignment of new changes with the workflow of an organization is necessary before validation. This will ensure a high level of compatibility in the processes, which will go a long way toward realizing the goals of the organization.

The validation process is complex, and it must follow certain stages to achieve the intended goals. First, there is a need to ensure that a specific language has been designated and confirmation of proof for structural correctness done. This step is key for having a successful validation process (Loo & Loo, 2013). This means the structure of the organization needs to be well known and understood together with its principal activities. Note that in large and complex processes, there would be difficulty in capturing the flow of data. Therefore, the experts are required to deduce the specific data needs skillfully. This would ease the design of the workflow since the attention of the Workflow Management Systems would be on the overall synchronization of activities (Margaria & Steffen, 2014)). This understanding compellingly paints a picture of a complex process of designing and implementing a workflow process. Therefore, a simple model based on activities would be the best approach.

There are three current best practices in validating workflows/processes for automating the current workflow. The first practice is the creation of a culture of embracing the quality of data. All stakeholders should know that data is no longer a function of IT; instead, it is an instrument of IT, which supports any organizational requirement (Miller & MacCaull, 2009). This culture is critical when embracing automation of data validation because every individual needs to have a portion of clean and dependable data. The other practice involves the stability of the data structure. When automating data validation, one needs to ensure that the timing is appropriately checked, particularly on the status of the data systems and its attributed infrastructure. Ensure they are well set. Once you have done automated process validation, and when such a process is implemented in an existing system, ensure that it is begin monitored to ensure that all data processes operate smoothly. During monitoring, the quality of data can be checked when the automated alarms are off and undertake front-back checks. The practices are critical in ensuring that the process of a healthcare organization runs smoothly (Lenz, Peleg, & Reichert, 2012).

Therefore, and for this reason, researched run a validation task on the proposed workflow processes with some of the participant from both facilities in addition to other HIS's expert to have a clear picture of their inputs on the design and its suitability, usability, performance and efficiency from different prospective.

Next section will present the analysis and findings of the workflow process validation phase executed.

5.11.3 Validation results and analysis

This section discusses the finding and results of the workflow process validation task that took place to confirm validity of the proposed HIS workflow process and its appropriateness to organizational needs and user satisfaction when implemented. Therefore, this section responds to the fourth objective of the study of validation. The validation aspects investigated for the proposed workflow process focused on the following:

- Patient safety
- Mapping and alignment with HIS current workflow
- Suitability of design with the facilities needs and requirements.
- Efficiency and cost effectiveness
- Possessing a user-friendly process.
- Opportunities for improvements.

- Implementation chances of such process.
- Acceptance and adoption by users.

The interview survey was conducted among 20 participants. Participant's backgrounds included HIT experts as well as the some of the same participants group of this study. Validation aspects was designed in the form of survey to explore the participant's attitude and opinions on these aspects in term of HIS proposed workflow appropriateness. Prior the conducting the survey, the proposed workflow process design was introduced and presented in depth to all participants so that they are ware of all details of the proposal and can produce a fair judgment on the proposed workflow process presented. These data collected from participants were analyzed to come up with the final feedback from participants on each of the aspect which in turn will form a comprehensive opinion towards considering the proposed design in mitigating Opioids abuse issues.

Therefore, the below discussion presents the findings of the validation process and how participant perceived the proposal. Overall, the validation was to meet the requirement of one of the study objectives as stated below:

Objective 4: To validate the proposed HIS workflow processes by exploring participants and experts' impressions on the proposed interoperable HIS workflow process.

• Analysis of validation aspect:

1. Workflow Processes Present Patient Safety Consideration

The first aspect validated for the proposed workflow process design as patient safety. Patient safeties represent a vital concern to all health care organization including health care providers. The results of the study for safety aspect show that 70%; 14 of the 20 participants strongly agree, and only 30%; 6 of 20 agrees.

The ability of health staff to promote a safe workplace is determined by their ability to identify and implement effective safety practices including the safety measures built in their HIS.



Figure 5.18: Patient Safety Consideration

The results show that 100% of the respondents agree that the design support patient safety in term of overdoses consequences as well as care provide avoiding duplicating the orders of a drug. Also, to facilitate the clinical workspace, ensure a rapid response to patients "needs, eliminate inefficiencies in the process of delivering care (Steckowych & Smith, 2019). To ensure that care providers" attention remains focused to minimize distractions and delays caused by the lack of relevant information. Developing the best processes and workflows can be applied to a wide range of healthcare systems, from hospitals to hospitals and healthcare homes (Traoré *et al.*, 2019). Each institution is different and requires the best future states to be considered.

2. Workflow process model possesses a User-Friendly process

Results show that 85%; 17 of the 20 participants strongly agree, and only 15%; 3 of 20 agree that the need to be more competent in all aspects of information technology to maintain a higher level of patient care. However, physicians and pharmacist have become increasingly aware that technology is positive insofar as its acceptance is essential for successful system implementation (Steckowych & Smith, 2019).



Figure 5.19: Process model Statistics

The conceptual foundation of practice has now been established in facilitating access to knowledge and resources through the ease of use and not simply providing care, and the conceptual foundations of practice have found their way into the core of healthcare education and practice (Rossetti *et al.*, 2019). Most physicians and pharmacist today have a positive attitude toward the reduced workload that comes with using a well-thought-out system. However, these advantages cannot be achieved if the workflow is not considered, and the
technology is implemented in a sophisticated way. A user-friendly interface can facilitate and reduce system resistance.

3. Potential for work efficiency and cost effectiveness

The results of this study show that 60%; 12 of the 20 participants strongly agree and only 40%; 8 of 20 agrees that presented workflow processes model has the potential be an efficient tool in providing care through the control of opioids abuse as well as reduction in cost for admission and relevant services. It was obvious that by increasing the quality and efficiency of health services in Croatia and other countries, the days of treatment in health facilities could be minimized (Pilkington *et al.*, 2019).



Figure 5.20: Potential for Work Efficiency and Cost Effectiveness

Given the high costs associated with managing Opioids and other controlled substances abuse patients, improving a HIS process to work with abuse patient would play an important role in cost reduction in term of admission expenses for the sick overdose patients as well as cost of medication and disposal of used drugs. Both physician and pharmacists strongly support an interoperable HIS that can play multiple roles other than just improve patient care and reducing cost on health care facilities.

4. Mapping and alignment with the current HIS workflow process

The current results show that 95%; 19 of the 20 participants strongly agree and only 5%; 1 of 20 agrees, based on data from observational audits and qualitative interviews, we have developed the workflow process that maps and is aligned with the current HIS processes. So, users are not having a conflict or a new process that may confuse them and cause a workload overwhelming. Mapping and aligning the current workflow illustrate the relationship between patient physical flow and systematic workflow (Harrod *et al.*, 2019).



Figure 5.21: Mapping Alignment with Current Workflow in Healthcare

Physicians and pharmacists strongly agreed that new processes of the workflow targeting the exchange of health information is not affecting the current system workflow, instead it provides an early identification of abuse patient in a way it allows to provide a better patient care. The mapping of processes enables the identification of workflow problems that influence the time of information exchange at check-in and thus promotes a holistic team approach to manage the patient care well.



5. Design Suitability for healthcare organization needs



The results of the study show that 70%; 14 of the 20 participants strongly agree, and only 30%; 6 of 20 agrees that such a design would fulfill the departmental needs regarding monitoring and tracking Opioids and even other controlled substances abuse patients. Looking at what the new workflow process possesses, no extra steps requiring user interaction exist, therefore, it should fit user satisfaction and respond to organizational needs in curbing and controlling Opioids abuse issues. Validation participants view the new workflow design as a suitable effective process that may add value to decision making process when monitoring and managing abuse patients all over the country.

6. Opportunity for futuristic improvements

Results shows that 60%; 12 of the 20 participants strongly agree, and only 25%; 5 of 20 agree, and 15%; 3 or 20 acknowledged new processes always has the chance for improvements according to organizational needs and future progress.



Figure 5.23: Opportunity for Futuristic Improvement

Such design would be used not only for opioid monitoring and tracking but can be upgraded in the future to track and monitor other non-controlled drugs as well as additional information related to patient.

7. Do ability- workflow process is a doable and implementable

Results presents that 60%; 12 of the 20 were strongly agreed and only 40%; 8 or 20 were agreed that presented workflow process to control Opioid abuse using the current HIS is implementable since they have already their own existing system with a great technical infrastructure. Participants appreciate pushing the exchangeable information retrieved from somewhere else to viewed within the same patient chart window. This facilitates their job and save times of navigating.



Figure 5.24: Workflow Process is a Doable and Implementable in Healthcare

Physicians and pharmacist are interested in implementing tools to improve existing practices and insights from the new workflow processes of frontline physicians and pharmacist in the room in which they work. Some participants had stated they had worked on similar HIS processes outside the Kingdom, so they believe it is doable with current state capabilities. As well as implementing would as a great value of patient care provided.

8. Acceptance and adoption by users

The results denote that 65%; 13 of the 20 were strongly agreed and only 35%; 7 or 20 agreed that the proposed HIS workflow processes provide an acceptable process as it will promote the patient safety and ease the use of the system compared to its unique integration with the organization HIS.



Figure 5.25: Feasibility can be Accepted and Adopted by Users

Ami-Narh and Williams (2012) claimed that little attention is given to technology acceptance and adoption developing countries. Physician and pharmacist in this purposive interview stated that adoptability of the new process depends on multiple factors such involving the user in the initial design, alerting staff of the expected changes and outcomes, and providing enough sufficient training to resources as well as the continuous support. All of that should promote adoption of the changes may occur with the current HIS. Therefore, a great amount of attention toward facilitating the adoption of the new process when using the HIS is of a crucial importance to user and organizations.

Some more results can be presented based on Awerness and significance of the abuse issue (Figure 5.26), E-prescription sactifaction rate (Figure 5.27), Exchanging information privilege (Figure 5.28), and Integration futeristics perceptions (Figure 5.29). From the results several points are observed which are inline with the objectives and research questions. Among all the participants 82.5% were aware of the abuse issues in Saudi Arabia. For the same groups 92.5% think controlled substance abuse or misuse is

a significant issue in the country and requires an intervention to control it. Among all the participants 77.5% strongly agreed that Electronic prescription tool provides a safe, quick and accurate practice when prescribing medications. E-prescriptions were highly preferred by the physicians and pharmacists to take control over the situation of drug abuse or misuse, but this works only within the organization. Among all the participants 95% (physicians and pharmacists) stated that there is no integration or connection of their health information system with other an external system or hospital. Both the pharmacist and physicians stated that only an internal system (within their own organization) for tracking patient records existed. Both physicians (95%) and pharmacists (100%) support the automation of healthcare settings. Interviews also showed Physicians (95%) and pharmacists (100%) support the implementation of an interoperable centralized information system (IS) to track and monitor the abuse and misuse of controlled substances.



Figure 5.26: Awerness and Significance of the Abuse Issue



Figure 5.27: E-prescription Sactifaction Rate



Figure 5.28: Exchanging Information Privilege



Figure 5.29: Integration Futeristics Perceptions

5.12 Summary

This chapter has presented the findings and analysis of data obtained and collected from the questionnaires, interviews, observation, and organizational documents. Opioid abuse issue was significantly existing in Saudi Arabia as per respondent's experiences, patients are easily getting addicted to Opioids and other controlled substance due to poor information management among health care facilities. This was witnessed by physicians and pharmacists who mostly and frequently deal with the abuse patients. Most of the hospitals in Saudi Arabia are either fully automated or semi-automated in term of the HIS they are using to manage patient.

Abuse information on patient is limited within a single organization boundary. They do not share patient health information with other health care facilities. This is due to the lack of an integrated clinical information system processes that can facilitate the patient information flow. The lack is existing because there is no standardized terminology for clinical information in addition to different HIS vendors. This resulted in creating a gap of information exchange, the fixes of this gap can help in a proper decision-making process by health care providers when managing abuse patients.

Validation of the proposed system workflow processes was very supportive to consider such a proposal for managing Opioids abuse issue in Saudi Arabia. Validators showed a great amount of enthusiasm toward implementing such a process to help mitigating the opioids and other substance abuse issues in Saudi Arabia.

CHAPTER 6: DISCUSSIONS

6.1 Introduction

This chapter of the thesis discusses the findings in relation to the research objective highlighted in Chapter one. Discussion in this chapter involves findings from the initial survey, observations, and interviews analyzed in Chapter 5.

This discussion presents more in-depth highlights on findings and explains the participant's opinions and attitude regarding the research questions illustrated in chapter one. It also includes more elaboration on the findings of the validation feedback from participants on the proposed HIS workflow processes. Validation of the proposed workflow process was a crucial objective of this study to confirm the proposed workflow process acceptance and adoption in future if implemented in health care organizations.

6.2 Discussion of Findings

Objective 1: To explore the magnitude of the opioid abuse issues in Saudi Arabia within the context of improper HIS design to identify abuse patients.

Based on the results obtained through primary and secondary sources, some points can be clarified. Mainly, it can be said that the reliance of Saudi Arabian health care system over information technology is on the rise. Most of the hospitals in the country are automated or semi-automated. There is however a clear lack of focus towards interoperability and integrated HIS. From practical point of view, it is important for the healthcare system in Saudi Arabia to realize that there are various areas of the healthcare system that gain patient information at different stages. If there is a well-integrated information exchange system in place, the overall productivity and efficiency of the Saudi healthcare system can improve a lot. The healthcare professionals including the ER consultants and the pharmacists believe that there is an existence of substance abuse or misuse which has increased in the country. The importance of this substance abuse issue cannot be ignored. Saudi Arabian healthcare system has improved over time and use of opioid as painkillers is common. However, despite this realization that substance abuse or misuse is growing, the focus on countering the issue is limited. There are some efforts being made but there is a dire need of making more efforts in this direction.

An important point that can be noted is that while there is a clear gap that exists in the HIS as far as HIE is concerned, there are various loopholes which the patients can use to continue the abuse of opioid or any other painkiller they get addicted to. Patient awareness is one intervention. The more the patients know, the better they would be able to avoid getting addicted to the use of opioid in any excessive quantity than they need. However, even if the patients are aware of the misuse or abuse of opioid, it is possible that due to regular use of the substance, they get addicted to it to the degree that they would need treatment for the same. The obvious way to follow for Saudi Arabian healthcare department at this stage is to share healthcare information. HIE can make it possible for the physicians, pharmacists and even the hospital administrations to focus on this issue in their administrative capacities. There is a dire requirement of paying official attention towards this issue.

Although not every patient reaching the hospital needs to be treated with opioid for painkiller, there are various patients who get addicted to the abuse or misuse of opioid due to their treatment. With an efficient HIE system, the health department can develop interventions that can help in not only keeping an eye on the patients who have received opioid regularly as part of their treatment but also those healthcare professionals who have access to opioid. HIS if well integrated can help in identification of the extent or magnitude of opioid abuse issues. The nature of this abuse, the level of seriousness of the issue developed in different cases, and the possible interventions to ensure that the patients taking opioid for painkiller must not become addicted to it; all of this can be achieved by having more information about the whole process though effective HIE. This is in turn possible only through a properly designed and well-integrated HIS.

Data collected in this research has shown that not the opioid misuse or abuse is noticed by the physicians and pharmacists. Also, the role that HIE and a well-integrated HIS can play in controlling the magnitude of opioid abuse is also understood by them. The future of healthcare system in Saudi Arabia can be very bright in terms of controlling the misuse or abuse of opioid usage by relying more on well-integrated HIS and interoperability.

Healthcare system in Saudi Arabia is semi-automated. However, the country still needs to focus more on its use of HIS and HIE in the future. A basic process in simplified form that the country needs to follow at this stage is to realize the outcome that it desires. The focus will obviously be to keep the substance abuse under check in the country. The existing state needs to be understood in detail too. Only by knowing how the system exists today, and what the desired output of the system is, the steps can be designed and taken to reach the desired output.

In this case, focus is on the prescription of opioids drugs and any related information about prescription in the HIS. Some medicines like opioids need to be prescribed only under check. Even though most of the systems in the Saudi Arabian hospitals are semiautomated, the prescriptions are mostly not e-prescriptions. Mostly the prescriptions are offered by the doctors without entering the requirements in the integrated HIS. Pharmacists and doctors who must prescribe or give opioids to the patients must focus on entering this information in the system. The system can keep track of the patient history and in any future purchase of opioid it can inform the relevant doctors or pharmacists. Eprescriptions can ensure that only the quantity of opioids that is required by the patients to kill their pain is taken. Any other dosage should be considered as an abuse of opioids. If the attitude continues, the system can mark that patient automatically as the one who is misusing or abusing the substance.

Objective 2: To identify the current process on prescribing Opioid's drug using HIS in Saudi Arabia while exploring physician and pharmacist perception on the usage of current HIS regarding Opioids drug abuse.

Healthcare professionals, doctors, and pharmacists are under the impression that existing HIS and HIE system has the required efficiency to not only provide necessary care to the patient within the healthcare facilities in Saudi Arabia, but it will also be able to keep an eye on the patient to report any substance abuse or misuse. However, at present although the hospitals are semi-automated, the information exchange system in the healthcare information system is not that efficient.

Also, despite having these automated systems, the healthcare information flow is restricted. The e-prescriptions are thus not providing the comprehensive information that can help the pharmacists or doctors to easily identify if a patient has developed a tendency of substance abuse. The focus at this point needs to be brought not only on the issues pertaining to use of e-prescription but also about developing interventions which can make the whole healthcare information exchange more reliable in Saudi Arabia.

Doctors and pharmacists must prescribe medicines and dispense medicines to the patients. Knowledge management and information exchange can help them in making informed decisions regarding the patients. Situation can improve a lot if within the current system, e-prescription is added as a mandatory step to all health care facilities. Information regarding all patients who are on opioid must be there in the system. Healthcare information exchange should also be facilitated. The healthcare information system can drastically improve the results of substance abuse control if there is ample information available to the pharmacists and doctors to make informed decisions regarding the patients' opioid usage. The healthcare professionals already perceive that this system must be good enough to provide them the required information. This might prove to be challenging, however. A change in approach is required in this regard so that HIE is given all due importance. There are however issues like information security and patient privacy rights which create hurdles in achieving this target. A balance needs to be achieved in this regard between the two important aspects of patient security and privacy and control of opioid and substance abuse.

Objective 3: To propose an enhancement of the current workflow processes of the HIS to mitigate opioid drug abuse issues.

The solution to the problems identified in this research is an interoperable, integrated HIS workflow processes which can help in mitigating any abuse issues in Saudi Arabia. Importance of healthcare system in provision of modern healthcare cannot be challenged. To ensure that the public benefits from the existing system of healthcare provision, healthcare information system has become very important. More than the HIS, the importance of HIE needs to be realized. At present, there is no integration among the HIS's of different hospitals to share information. The systems are limited in most of the hospital boundaries. As a result, interoperability is also limited which is a handicap in this situation.

HIE can prove to be a game changing step in the overall healthcare information. In general, there is a need for a centralized system that can handle, and store information about the treatment of abused patients. One aspect of this system would be the provision of the information that can be collected by the system regarding the use of opioid in treatment when a single or multiple integrated system are down for any reason. At present, the focus of the HIS's developed by the hospitals is that these systems should provide them operational efficiency. The focus needs to be brought on the fact that an integration of the same system with focus on better medical planning and substance abuse control can bring positive changes.

Another important point that needs to be integrated is that an ideal and comprehensive system that can help Saudi Arabian healthcare department in keeping a close eye on substance abuse and which can also be used for improving healthcare provision would need major investment. This might not be something that every hospital can achieve on its own. There is a dire requirement of a centralized effort to change not only the prescription approach but also the data collection and knowledge management as handled by the Saudi Arabian healthcare department at present.

Without having an automated system that can keep an eye on the patients and the abuse of opioid, it will not be easy to keep track of this substance abuse or misuse. This is because the interoperability or information exchange requires dedicated personnel. In this case, the emergencies are using maximum opioid as that is where the most painkillers are utilized. The doctors and other healthcare professionals associated with the emergency services are almost always overworked. They are not in the position to focus on the information of opioid abuse in the system. They can only facilitate the system by eprescribing the medicine. The human resource that needs to be invested in this field for running the system to obtained useful results need to be specifically trained and well oriented for this task.

The interoperability that can have an overall impact over the opioid abuse in Saudi Arabia is possible only if the multiple HISs being currently in use by different hospitals are well

integrated and are put together so that the information can be collected at a wider scale. There are various opioid use disorders along with the abuse of the substance or its misuse which need to be focused on. However, without having a centralized integrated system it is difficult to achieve. The HIS workflow processes thus need to be capable of mitigating abuse issues through HIE or interoperability. Without that, the system can only provide a certain level of efficiency to the hospitals.

Proposed HIS workflow processes is focused on the real time information availability regarding patient's medical history. This information can make all the difference regarding substance abuse and its control in Saudi Arabian hospitals. Addiction, misuse, and abuse of opioid and other issues pertaining to overdose of opioid can be controlled if the proposed HIS is followed.

The benefits that can be drawn from the workflow process of the integrated HIS cannot be undermined. They can be truly visualized if interoperability is made possible. The focus needs to be on timely availability of the health information. There are more benefits of the proposed system workflow process. The patients who are brought to emergencies are usually unconscious. Even if they are not, they are mostly not in the condition to explain their medical history carefully. Integrated HIS can help in keeping the information required handy for the doctors and paramedical staff to use.

Objective 4: To validate the proposed HIS workflow processes.

HISs in the hospitals are quite efficient in Saudi Arabia. There is however a clear need for the system to focus on an integrated approach. There is also a major requirement of information exchange across different health care organizations. Along with the approach of improving the efficiency of the local system, the focus should also be on the overall efficiency of the health care system in Saudi Arabia. Opioid abuse can be controlled if the proposed system workflow process is followed. It can help in information exchange and exchange which will in turn help in better knowledge management and patient record and history management. Healthcare faculty might need the information about the patient in different situations. HIE is possible by following the proposed system workflow process. Better informed decisions can be made by the doctors and pharmacists and other care providers.

One of the most important aspects which can define the success or failure of the workflow process would be how it reflects on the patient safety measures. If a new system proposed for improvement in HIE can make the patients vulnerable, it cannot be appreciated. However, the research shows that the information technology based system suggested here is the one which can help the hospitals and healthcare department not only in controlling the abuse or misuse of opioids but it is also focused on patient safety. In the healthcare profession, patient safety is the utmost goal. As this system workflow process provides an exchangeable healthcare information to protect the patient from harm, it is has received high approval rate by participants and HIS expert.

The approval of workflow process needs to come from the stakeholders involved. The patients, the information technology experts who understand the value and complications of HIS, the medical and healthcare professionals and even the administrative staff of hospitals needs to be sure about the benefits that can be drawn from the workflow process. The workflow process model shared here is user friendly. Not only the system needs to be good from technical point of view, the administrative staff and the healthcare professionals can only rely on it if it has an interface which is easy to use. In this case the focus has been on this aspect and thus the stakeholders involved can rely on the system. HIE can help the patients vastly as it will be an automated tool to ensure that abuse or

misuse of opioids can be controlled and thus this system has received approval from the participants of this survey.

One important element to consider for any healthcare information system is its cost effectiveness and the efficiency it adds to the system. The workflow process suggested here is quite good in the sense that it is cost effective. Using such a workflow system would not only help in cutting out some steps which involve a lot of manpower but also in the long run data retrieval and maintenance would also help in informed decision making. This would have a direct impact over not only the cost of managing abuse patient, but also it would add a lot of efficiency to the system users from different aspects.

A problem that many healthcare institutes face when they must adapt to a new technology-based system is the change management process. When the organization has to shift from an existing model which has been in use for quite some time to a new one which is more technical and advanced, the new system not only needs to map the existing system but it needs to align with the existing HIS processes. Only then it is possible for the new system to prove useful without creating any data loss or misuse situation. Medical patient history and other personal data that is stored in HIS of any medical facility is sensitive data and these organizations are responsible about the same. Thus, mapping and alignment becomes an important factor of the new workflow processes proposed.

The new system that is proposed for the workflow management here carries a high degree of suitability to be employed in the healthcare environment. A major reason that can be identified in this regard is that this system not only can align with the existing HIS, but it has a possibility of futuristic changes that can help to further modernize the system. It is important because the use of technology in healthcare information management is an ongoing process. With the passage of time more and more information exchange systems will be introduced which can enhance the performance and efficiency of the healthcare information exchange process. Thus, the new workflow process can only be considered useful if it is suitable for future growth and adjustments as per the technological changes which will take place in the future.

Along with all other elements that make this proposed workflow system a suitable choice here, the fact that it is doable, and it can be implemented is one major decisive factor which goes in the favor of this proposed system workflow process. This system workflow processes can be used and implemented along with the existing systems. This is the reason that the healthcare professionals and HIS experts participating in this survey have approved the proposed workflow process to be implemented for control of abuse or misuse of opioids.

6.3 Summary

The magnitude of the issue that exists in Saudi Arabia is understood quite well by the medical practitioners and pharmacists. Opioids are used as painkillers and if proper care is not taken, it is possible that the patients get addicted to the use of opioids. Substance abuse or misuse is something the doctors and the pharmacists are aware of. The number of such cases is big enough and it must not be ignored. Steps need to be taken to control this issue.

Currently the hospitals and healthcare facilities mostly are automated or semi-automated in Saudi Arabia. The information collected about the patients goes through the individual healthcare information systems of the hospitals. The healthcare information systems are however not integrated with each other. As a result of that, HIE is very limited. This leads to obvious loopholes in the system where the doctors and pharmacists realize that substance abuse problem is there, but they cannot do much about it due to the lack of synchronized HISs.

This requires the healthcare facilities overall to have focus on interoperability. The more well connected the various healthcare information systems would be, the better would be the chances to control any abuse or misuse of opioids in the hospitals. HIE requires proper HIS workflow processes to be followed in these hospitals which is proposed here. The workflow process has received approval from the participants as it meets all major requirements. This system helps to facilitate the exchange of healthcare information and thus helps to control and reduce the risk of abuse or misuse in Saudi Arabia.

CHAPTER 7: CONCLUSION AND FUTURE WORK

This section concludes the research by providing the summary of the research along with a discussion on the limitations of this research, its contribution to this field of study, and the possible future research which should be conducted to further clarify this area of study. This chapter focuses on the success of this research in the light of the objectives that it had, and the discussion on the findings based on the survey, observations, and the interviews. Summary of this research is presented as an overview of the process through which this research has been done. Findings from this research are further highlighted in this section. To meet the objectives, not only the existing situation in the hospitals is studied but the focus is also on the proposed HIS workflow processes. For the future acceptance of this proposed HIS workflow process, its validation is importance for its future utilization. Along with that this section will also discuss the limitations of the HIS workflow processes and this research as well.

7.1 Introduction

This research is focused on interoperability which would help in effective deployment of healthcare information system in Saudi Arabian healthcare sector. Drugs and opioid abuse programs can be improved a lot by relying more on well-integrated healthcare information system. Healthcare information systems need interoperability. This research is focused on exploring the magnitude of the opioid abuse issues in Saudi Arabia within the context of improper healthcare information system design to identify abuse patients. Data collected from the participants show that the healthcare professionals are aware of the drug abuse that is taking place in Saudi Arabia at this point. Opioid is used as painkiller mostly in emergencies and in many cases the patients become addicted to it. This research has also identified the current processes on prescribing opioid drug using HIS in Saudi Arabia while exploring physicians and pharmacist perception on current healthcare information system use regarding opioid drug abuse. The research has shown that e-prescription tools can help in providing data which can help the existing HIS by standardizing orders entry to control drug abuse by relying on interoperability. However, this research has also identified that doctors and physicians are not always in the position to use e-prescription.

This research has proposed an interoperable, integrated HIS workflow processes capable of mitigating abuse issues in Saudi Arabia. However, there are various legal, financial, and awareness related issues which would need to be tackled before any such system workflow process can be applied. Research has shown that executing such a system would not only need heavy investment for infrastructure but also a lot of investment would be needed in the employee training and development section.

Proposing the HIS workflow processes is only one step in this research. The fourth and final objective of this research is to validate this proposed HIS workflow processes. For this purpose, the stakeholders who would be directly affected by this system or the information technology experts were asked to make their opinion. Participants and experts' impressions on the proposed interoperable healthcare information system workflow process showed that it is a system which has high chances of success. There are certain limitations attached with the model which can be overcome through proper planning and involvement of a centralized authority.

7.2 Summary of the Study

In this section, the whole study will be overviewed and summarized. The successful completion of any research project is dependent on the objectives of that research. Research problem can only be solved by meeting the research objectives and by answering the research questions. There are few important points observed from this study.

First and foremost, this study has confirmed that Saudi Arabian hospitals and the overall healthcare system is utilizing information technology more commonly today as compared to the past. More and more hospitals and organizations related to healthcare are using information technology for improving efficiency and making information retrieval easier. As a result of this positive approach towards use of technology in the healthcare industry, most of the hospitals are either automated or semi-automated. However, the problem remains with the issue of interoperability. HIS that is in common use in the hospitals of Saudi Arabia needs to be more integrated so that interoperability can make it more efficient.

Information technology-based healthcare information systems can help hospitals in keeping the use of opioid under control. However, there is a lack of a well-integrated HIE system. As a result, the patients, who get addicted to opioid after taking the same as a painkiller due to some emergency can use some loopholes existing in the system and get further involved in substance abuse. HIE can provide the hospitals and healthcare industry in general the access to the information about the opioid use as painkillers so that the patients who can get addicted to the same can be kept safe from the abuse and addiction. One intervention that is suggested by various healthcare professionals is that patient awareness level regarding opioid abuse and the associated problems should be improved.

Research shows that when patients are aware of the issues that they might face if they get addicted to any drugs, they tend to avoid it.

Even though patient awareness is considered as a good intervention, it is still possible that the patients who get to use a lot of opioids as painkiller get addicted to it. Some of them might get seriously addicted and they would need treatment to get rid of their addiction. This healthcare problem can be avoided by having an efficient HIE system. The existing healthcare information systems of different hospitals can be integrated properly so that the information exchange becomes easier among these hospitals.

7.2.1 Overview of the study

As per the opinion shared by the ER consultants and pharmacists, healthcare information exchange will facilitate the administration of any healthcare facility in keeping a check on the abuse or misuse of opioid by patients. Physicians and pharmacist can also get access to this information. However, as it involves a lot of confidential patient information, it can only be done at an official level with government approval. Many patients who reach the hospitals need opioid as painkiller and as a result they get addicted to it. If the addiction is not controlled, it is possible that the benefits that opioid can offer as painkiller become less valuable due to the problem that its use is causing. However, if the HIE system is well-integrated, it is possible for the healthcare department to not only trace the abuse or misuse of opioids but also to develop interventions for ensuring patient safety. Sometimes employees also misuse the substance as they have easy access to it. With an integrated HIE system, this can also be controlled. Research question 1: What is the extent of opioid abuse in Saudi Arabia from a physician and pharmacist prospective in term of HIS usability to control abuse issue?

The research shows that if the HIE system is built with an integrated approach, it can help in identifying the level and magnitude of the opioid abuse. The nature of opioid abuse is to be understood clearly and so is the seriousness of the issue in different patients who get addicted to opioids. Based on this information, it becomes possible for the healthcare industry to intervene and ensure that there is no abuse of opioids by the patients. The system of information exchange can help in quick and reliable exchange and retrieval of patient's information. The requirement of a well-designed and well-integrated healthcare information exchange system thus can help the Saudi Arabian healthcare industry in controlling the opioids abuse or misuse by patients.

The initial data that were collected through this study created a clear understanding that physicians and pharmacists have noticed that there is a possibility of opioid abuse if patients become addicted during emergency treatment. They also understand the role that healthcare information system can play in controlling the abuse of opioid. Research has also shown that in the future, Saudi Arabian healthcare sector would be able to strongly control the abuse of opioid because it is relying heavily on great information technology infrastructure. Information technology-based healthcare information system can help Saudi Arabian hospitals in controlling this issue using interoperability.

The positive outlook on the future of HIS is based on the fact that Saudi Arabia's hospitals are semi-automated. Some of them are already automated. These hospitals rely on efficient healthcare information systems. The infrastructure is already in place. The focus is required to shift towards the future efficiency and interventions based on technology based integrated information exchange systems. Future developments of the healthcare information systems must be done based on the objective that the healthcare system has. At this point, the objective is to ensure that the abuse of opioid in the country should be controlled. Having an effective and efficient healthcare information exchange system can be the answer which will resolve this issue by providing the output that is required here.

The simplified system that must be followed by the healthcare sector, is to review the existing situation and compare it with the desired outcome. Depending on the gap that has been identified, various steps can be taken to fill this gap. The focus should be on the opioid prescription and the fact that such prescriptions must not be without complete checking. However, under the circumstances, in many cases the prescription of opioid use is not e-prescribed and that means the prescriptions are not a part of the healthcare information system. The integrated HIS can only help in resolving the issue of opioid abuse if the required information is entered in the system by the doctors or physicians prescribing opioid. If the healthcare information exchange system has this information, the patient history can be tracked easily even if the patient tries to get opioid prescription from a different hospital. E-prescriptions are the answer here as it can help in keeping track of the dosage of opioid being taken by the patient. There is a certain amount that is required amount, it should raise an alarm through the integrated healthcare information system.

According to the opinion shared by the ER consultants, pharmacists and, the healthcare information system that exists now is quite efficient. This system is suitable to provide healthcare support to the professionals at the time of treatment of the patient. The system can also keep an eye on the opioid abuse by the patients, but this remains with the same organization boundaries. The problem, however, is that these hospitals are not using interoperability to share patient's relevant information.

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Research question 2: What isare the current processes in prescribing Opioids drug using HIS in Saudi Arabia and what are the perceptions on the use of current HIS among physicians and pharmacists in Saudi Arabia?

One of the major problems identified by the healthcare professionals in the existing healthcare system is that the systems are automated but with the restricted information flow. E-prescriptions are thus not being in use effectively. The comprehensive information that is required by the other healthcare professionals to identify any abuse or misuse of opioid by the patients is missing. Proper use of e-prescriptions can prove to be a major intervention in the healthcare sector's focus on controlling opioid abuse. Also, there is a requirement of further interventions that can make the healthcare information exchange system more active, reliable, and efficient.

The role of proper knowledge management in the healthcare sector cannot be undermined. Having complete knowledge, about patient history can help the pharmacists in keeping an eye on opioid misuse. The doctors can also benefit from having an efficient knowledge management system while prescribing and dispensing medicines to the patients. As the existing infrastructure of information exchange is not bad, it can be said that using eprescription can resolve a lot of issues regarding misuse or abuse of opioid by patients. Making e-prescriptions a compulsion can help in this regard. The system must have all entries pertaining to the patients who must take opioid as painkiller. This can also be facilitated by active healthcare information exchange system. This would help in improving the overall healthcare information system that exists in the country. This would also lead to the point where availability of the information at the right time will help the pharmacists and doctors to take preemptive measures to control the use of opioid.

Although, the healthcare professionals are of the opinion that the existing system is quite well equipped, there can be various challenges for the existing healthcare information system to play the role required for tackling the abuse or misuse of opioid. A possible solution to this problem and an answer to this challenge would be the change in approach regarding information exchange in healthcare. Healthcare information is mostly confidential, so the healthcare information exchange system faces the patient privacy issues. From information technology point of view, there are various privacy related issues to be tackled to overcome the legal challenges. This issue can only be resolved if a balance between the legal privacy right of the patient and information exchange is considered. The availability of information can help the whole system in case of opioid abuse.

Research question 3: How can a HIS participate in mitigating OpioidsOpioid's abuse issues in Saudi health care system?

A comprehensive and workable solution is provided to this challenge by the research at hand. Interoperability can be considered as the solution to the problems identified here. If the HIS workflow processes are integrated and interoperable, the abuse of opioid can be mitigated. Every industry and sector nowadays are focused on improving the efficiency of whole system by relying more on the information technology. Modern healthcare also needs to rely on the same. Although the healthcare professionals mostly realize that healthcare information system is very important to modern healthcare system, the role of healthcare information exchange still needs to be clearly understood. Existing healthcare information systems. There is no existing method of sharing information with each other. As a result of the limited approach of healthcare information management that these hospitals have applied, the information exchange and interoperability is also limited in these hospitals.

The importance of HIE system can be truly understood if the focus remains on modern healthcare system and future of healthcare in Saudi Arabia. In general, it can be said that healthcare sector needs a centralized system which is not only interoperable, but which also can store all required information about the patients taking opioid and their treatment. When any health organization system is down, the central database of the interoperable system would be able to provide information regarding opioid abuse. This can help in controlling the abuse in a reliable manner. At present the hospitals are only focused on gaining efficiency. The efficiency they look for is meant for improving the workflow processes and patient care. However, these hospitals and healthcare organizations also need to focus on the medical planning aspects which can help in controlling opioid abuse or misuse. Substance abuse control is another target which should be the focus of healthcare sector.

According to the study, a major challenge in building an interconnected, integrated healthcare information exchange system in Saudi Arabian hospitals is the huge investment that will be needed to create such a system. On the one hand, the issue is that small hospitals may not be able to invest the required amount, which has become a part of this interoperable system. On the other hand, if a government level centralized effort is made, the training and development of the healthcare employees to make good use of this modern system would also require investment. However, even though having an interoperable, well-integrated healthcare information exchange system is a costly option, it is an option that the healthcare sector in Saudi Arabia cannot ignore if the substance abuse is to be controlled.

Research question 4: How do participants and HIS experts perceive the proposed workflow process compared to their current HIS practices? Having an automated system can help the healthcare sector in controlling any abuse or misuse of opioid. However, to put this system to effective use, there will be a requirement of the human capital that is well trained in utilizing the interoperability of the system under discussion here. Information exchange system needs maximum privacy and control. At present the emergency services in the healthcare sector are using opioid most frequently as painkillers. The healthcare staff working in the field is mostly overworked and they are not always equipped with the training required to operate the system in an efficient manner. The best use of the system would require personnel who are trained in using this system. E-prescribing should also be made a compulsion part of the system. As the human resource is specifically required for this task, their training is an important task. This is because the field of healthcare provision is a sensitive field. Proper training of the personnel will be a must thus.

In future of healthcare management sector in Saudi Arabia, interoperability can help a great deal in controlling the opioid abuse in the country. At present the hospitals are using different systems which are efficient, but these systems are limited to the hospital boundaries. There is no interoperability at this stage. Healthcare information exchange can be effectively used to control opioid abuse through interoperability. Basically, interoperability will help the overall system in collecting information from a wider source population.

Opioid abuse leads to various disorders. The abuse or misuse of opioid can lead to complicated healthcare issues. The opioid abuse or misuse is thus an issue which cannot be ignored. However, to control the use of opioid by the patients, the centralized interoperable system is required. In the absence of such a system, this objective cannot be achieved. The focus of this research is thus to propose healthcare information system workflow process that can help in resolving the opioid abuse issues. This would be possible by applying interoperability among the HIS's. If the interoperability aspect is ignored, the existing systems can only help the hospitals in some ways to improve their efficiency only within their local boundaries.

One of the objectives of this research was to propose healthcare information system workflow process which can provide real time information of the medication history of the patient. Such a workflow system can be put to efficient use through interoperability. With the help of the real time information being made available to the physicians and pharmacists, abuse of opioid or addiction can be controlled. Overdoses of opioid can easily be identified through such a workflow process.

There are several beneficial opportunities to the workflow process from integrated and interoperable HIE systems. Interaction will help to retrieve the majority of the information from a well-integrated healthcare exchange system. The actual difference would be brought by easy availability of the information at the right time. Although having quick retrieval of the required information is a major benefit, there are other benefits associated with this system too. For example, in many cases the patients coming to emergency are not in the situation where they can share their medical history in detail with the healthcare professionals. Having an integrated system can help at this point. The required information will be available easily to the healthcare professionals. Due to the availability of information to the medical team and the paramedical staff, the healthcare provision will be much better.

7.2.2 Strengths and weaknesses of the proposed HIS workflow processes

Although the existing system of healthcare in Saudi Arabia is quite efficient, there is a lack of integrated approach in this system. Healthcare information exchange is much required between different hospitals and healthcare organizations. Thus, the focus needs to be not only on the individual healthcare information systems in the hospitals but also on the HIS that exists overall in the sector. There is a serious need for an interconnected and integrated healthcare information exchange system. To overcome this issue, the proposed system workflow process can prove to be of utmost help. The major issue at hand is that information exchange is limited, and healthcare information exchange is not adding to the overall efficiency of the sector. Patient history management and records will help in better knowledge management in the industry. Different healthcare professionals might need information about the patients in different capacities and at different times. Having a well-integrated, interoperable system can help in this regard. For that, the proposed system workflow process can prove to be a great help. This system enhancement will help the doctors, pharmacists, and other paramedical staff in taking well informed decision based on knowledge provided to them by the enhanced system processes.

7.2.2.1 Strengths of the proposed HIS workflow

From healthcare professionals' point of view, an important point that cannot be ignored in workflow process is the measures to ensure patient safety. The patient safety measures can define the success or failure of the workflow process. Any newly proposed system that puts the life of patients in danger or makes their private information vulnerable or puts them at any kind of healthcare risk is not to be considered. However, the use of information technology in healthcare has helped hospitals in overcoming this issue. The HIS's workflow process suggested by this research is safe for the patients as it is only focused on the control of opioid abuse. This workflow process can be considered valuable because it ensures patient safety. Healthcare sector always needs to keep its focus on the safety of the patients. The exchangeable healthcare information provided by this system workflow process protects the patient and ensures patient safety; the approval offered to this system by the participants of this research was quite high.

For the system workflow process to be considered useful, its approval needs to come from the stakeholders who would rely on this system. The stakeholders that would get directly affected using this system or who understand this system would include the patients, the information technology experts, and the healthcare experts. The approval of the proposed system workflow process is high because this process workflow model is easy to use. It is technically strong and yet it offers an interface which makes it easy for the administrative staff to work on this system for further monitoring. The output of this system workflow process will be useful as it will help in control of the abuse or misuse of opioid by patients.

Although the participants of this research have approved this system, there are other important aspects about this system which needs clear consideration. First and foremost is the cost effectiveness. In fact, this system workflow process needs to pass the cost benefit analysis test. This research has shown that the system workflow process that has been proposed in this research is cost effective and it has added a lot of efficiency to the proposed system workflow process too. This system workflow process will enhance the efficiency of the existing system because it leads to cutting out some steps from the overall process. This would not only mean less requirement of manpower for completing the process but also that the retrieval of information at the required time will be easily possible for the healthcare professionals too.

Despite all the benefits that this system can add, there is a major problem for the Saudi Arabian healthcare systems to consider and that is the change management. The healthcare professionals and administrative staff of the hospitals is used to the existing system. Healthcare is a field where work cannot stop for making a major change to the system. It means that during the process of making this change, there could be a lot of resistance. There would also be a major requirement of training and development of the employees to be able to use this system processes. There would also be a requirement to ensure that medical patient history is stored in a manner that any data loss or data theft issues are not possible during the change. Mapping and alignment of the two systems is thus very important. The existing system should provide the base for the new system enhancements.

Suitability of this new system for its deployment in the healthcare system is quite high. This is because this system is suitable not only to make the currently proposed changes, but it is suitable for the futuristic changes as well. As the use of information technology in the healthcare department in Saudi Arabia is on the rise, the future will lead the healthcare industry towards more efficient solutions based on this proposed system workflow processes.

7.2.2.2 Limitations of the proposed HIS workflow

The limitations in this case include the limitations of the proposed workflow process and the research. The two most important limitations of the proposed workflow process include the fact that it will be costly and will need major investment, and that it will require major employee training to implement this system. Cost of the system enhancements is an issue as there are various hospitals which would need to coordinate with each other to find a solution to this problem. Every hospital is not equally equipped. The investment amount will also be a problem for many smaller hospitals. Cost of the new system, and the alignment of the existing system with the new system will be tough for many hospitals. This would lead to their resistance to this change. There is a major requirement of a centralized approach to handle this issue. There should be some incentives which can make the smaller healthcare institutes to participate in this new system.

The second most important limitation of this new system is the detailed training requirement of the employees of the hospitals who would be using this new proposed system. Healthcare information is sensitive, and the importance of privacy and integrity of the information cannot be ignored in this case. As a result, it is of utmost importance that the employees who would be using this system are properly trained to use it. There is no margin for making errors and thus training would be important. Training the personnel will be costly and time consuming and thus many organizations might not be too enthusiastic about it.

7.2.2.3 Limitations of the current study

There are a few limitations of the research overall as well. The first major limitation is that there are only two hospitals which are included in this research. Saudi Arabia has dozens of hospitals in each of its large cities. There are good hospitals in the smaller cities as well. The sample size studied in this case is thus too small. Although the study of these two hospitals is done in detail, and the information regarding these two hospitals is valid, the generalization of the findings might not be possible very easily in this case. Selection of these two hospitals is the time available for this research and the resources available to complete this task were limited.

Another limitation of this research is that the system that is proposed by this research is only conceptualized. There has been no effort made to develop or test the system. In the field of information technology, any concept that is to be put to common use needs to be developed and tested. There are various systems which might look very good in concept, but they might not turn out that well when the concept is executed. Although this system is developed in detail, there is a clear requirement of more focus on the practical aspect. Development of a prototype could have been possible if the time and resources had allowed.

Another shortcoming or limitation of this research is the lack of local research investigating the healthcare information technology issues. There is particularly lack of research regarding drug abuse control and how challenging the overall process is. Healthcare is a complex field and the role that information technology can play in drug
abuse control can only be limited. This research has not focused on the other aspects and challenges which would be important in controlling the abuse or misuse of opioid in Saudi Arabia.

A major problem that was faced during this research is, the confidentiality of drug abuse statistics by multiple governmental agencies limited access to the status indicators. An important problem in this regard is that it highlights the confidentiality issue that this system would also face. The biggest problem at hand is that drug abuse figures of private information of the patients cannot be easily shared or exchanged. Thus, a lot more work needs to be done to make practical use of the system proposed in this research.

7.3 Contributions

The most important contributions of this research include its theoretical contributions to the field and the practical contributions. Both will be discussed in the following section.

7.3.1 Theoretical contribution

From theoretical point of view, there are some major contributions made by this research. Importantly, it provides insight into exploring similar scenarios in different parts of the world. Healthcare is a field where the world needs to come together and support each other. This research can help in identifying similar issues in other parts of the world too. From theoretical point of view, another contribution that this research has made is to fill in the gap in research regarding drug abuse issues in Saudi Arabia. It has also helped in visualizing the current workflow and provided inputs for requirements and options which should be included in the future healthcare information systems. It has also highlighted the technical and operational gaps for improvement in the system for future.

7.3.2 Practical contribution

The practical contribution in this case is about getting insight of service providers' opinion on the abuse issue. It has also highlighted the need to strictly control drug prescription and dispensing. It has also focused on developing and regulating stringent IPPs. This research also highlighted the lack of details on drugs obtained from external parties and has focused on the importance of collaboration and interoperability of healthcare information systems. Another practical contribution made by this research is that the perception of participants regarding the abuse issues unveiled the current existing scenario in Saudi Arabia. It has highlighted the need for speedy policy making to overcome the drug abuse issue. This research has also provided doable solutions for how a support system can facilitate and improve controlling opioid abuse throughout the country driven by privacy and confidentiality laws.

7.4 Recommendations for Future Research

There are a few recommendations for future research based on the conducted research. More research is needed about ownership and responsibility of the process support system that crosses organizational boundaries. Such a system would support patient centered healthcare. Further research is needed on future process-based information systems that may be more inclusive and thus enable patients and healthcare providers to control and empower healthcare at different ends.

More research is also needed in how patient records and their medical history can be made easily available through a process support system. This must be done without violating the patient privacy and while ensuring patient security guided by local and international laws. Another aspect that should be researched in the future is the researcher's role in the future of healthcare information research. Researcher's role needs to be broadened to provide more futuristic insights on information technology contributions to patient care safety.

7.5 Conclusion

Just like any other healthcare system in the world, the healthcare system in Saudi Arabia also receives information about the patients at different stages. However, this information is not shared with the healthcare industry through a well-integrated information system. Having a well-integrated healthcare information system can help the system overall as the information collected at one point and at one time can be retrieved and used in the future too. It would also mean that the productivity and efficiency of the overall system will improve to a great level. In this research primary data was collected from healthcare professionals about the substance abuse or misuse in Saudi Arabia.

Pharmacists and ER consultants were contacted for collecting the data. The biggest issue, that was the focus in this case, was that opioid is commonly used as a painkiller. Saudi Arabian healthcare system has shown a lot of improvement over time. The healthcare industry is thus focused on ensuring that there are no drugs or substance abuse or misuse in the country. However, although the pharmacists and ER consultants believe that due to the use of opioid as painkiller, the addiction is on the rise, there are no concrete steps that are being taken by the Saudi Arabian healthcare system to counter this issue. Opioid abuse or misuse cannot be ignored, and it requires some serious efforts to overcome this problem. This research has also provided an insight into the prescription process. It has highlighted that e-prescribing can participate in solving this problem to some extent. However, the research has majorly focused on the interoperable integrated HIS workflow processes which will be helpful in controlling drug abuse in Saudi Arabia. This research

has also provided a positive validation feedback from participants and HIT experts which support this proposed HIS workflow processes.

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