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"The Impact of Implementing Electronic Medication Management System on Medication Safety practices: A case study at a Palestinian Tertiary Hospital"

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DECLARATION

This thesis was submitted in partial fulfillment of the requirement for a Master's degree in Health Informatics.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

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Date: 2nd October 2021

DEDICATION

This thesis is dedicated to:

I Would like to dedicate this thesis to:

My beloved family, who supported me all along,

My supervisor Dr. Yousef Mimi, who guided me throughout the academic years, Dr. Atef Al Rimawi who is a great boss and an amazing mentor, And finally, my second home, the Arab American University, for this highly valued learning experience

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I would like to express deep gratitude to my supervisors, Dr. Yousef and Dr. Atef; I would not have been able to attain this thesis without their guidance and endless support. It has been a great honor working with them.

I would also like to acknowledge my parents, siblings, and nephew for the confidence and faith they have put in me.

In addition, I wish to thank the Arab American University and the colleagues I have met along the way, and this journey has been a great learning experience that paved the way to a new chapter in my life.

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ABSTRACT

Background:

Electronic Medical Records (EMR) have aided health care workers in improving safety, but to date, there is few statistical evidence about the effectiveness of Electronic Medication Management (EMM) Systems in improving medication safety practices. This study aims to study the impact of implementing EMM system on medication safety practices in a Palestinian Tertiary hospital, Al Istishari Arab Hospital (IAH). The hospital reverted to using an electronic system after relying on paper medication order documentation. Therefore, this study provided accurate comparison between the paper and electronic medication documentation.

Methods:

Non-experimental pre-and posttest design. The design of the study used a quantitative analysis approach using an open chart review methodology (retrospective study) to determine the impact of implementing EMM Systems on medication safety practices.

Data was gathered from paper medical files and Kardex (medication administration record), over two months, and then gathered from the same departments using the EMR over three months. The tool used in this study is a Joint Commission International tool, which is used to study the compliance in complete medication order documentation. The results were compared and contrasted to see the effect of implementing EMM system versus paper documentation.

Results:

The medication orders collected through the paper phase were equal to 65 medication order. Meanwhile, the electronic orders were 141 medication orders. The healthcare givers' compliance with a complete medication order, though using the Traditional Paper Approach was equal to 70.5%. The compliance with a complete medication order through using the EMM System was equal to 78 %. The results showed a statistically significant impact with a p value = 0.00, on medication documentation after using the EMM system.

Conclusion:

Implementing an EMM system on compliance with a complete medication order has a significant impact on compliance, which predisposes to medication and patient safety.

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ABBREVIATIONS

ADRS	Adverse Drug Reactions
EMM	Electronic Medication Management
EMR	Electronic Medical Record
IAH	Istishari Arab Hospital
JCI	Join Commission International
NA	Not Applicable
ME	Medication Errors
PRN	"Pro Re Nata" in Latin, when necessary or when needed.
SPSS	Statistical package for the Social Science
Vs.	Versus
WHO	World Health Organization

CHAPTER ONE:

INTRODUCTION

1.1 Background

Documentation is a major function of healthcare practitioners (Scruth, 2014). Good documentation reflects the basic facts of patient care, including who did, what, and what happened. It gathers meaningful clinical details in one place, supplements the healthcare providers' memory of vital events. Documenting all complaints and symptoms helps healthcare providers care for the patient, identify patients' progress, and guide them in developing treatment care plans (Okaisu et al., 2014). Accurate and clear medical file documentation is critical to providing patients with; quality care, alleviating errors, mistakes, malpractice risks, and helping healthcare providers to maintain the continuum of care. Proper documentation provides legal evidence of the healthcare services provided, and sustains evaluation of quality patient care (Okaisu et al., 2014)

Among the broad criteria for quality documentation, the use of common terminology, clear and readable writing, and the use of approved abbreviations are of great importance in clinical documentation (Ofi & Sowunmi, 2012). Complying with the criteria mentioned earlier is as thoroughly as important as documentation elsewhere regarding medication-related documentation. This is due to the frequent reporting of medication errors (MEs) in the hospital settings, happening anywhere along the medication process (Hughes, 2008). Figure 1.1 represents the medication process, which consists of; prescribing, transcribing, dispensing, administering, and monitoring.

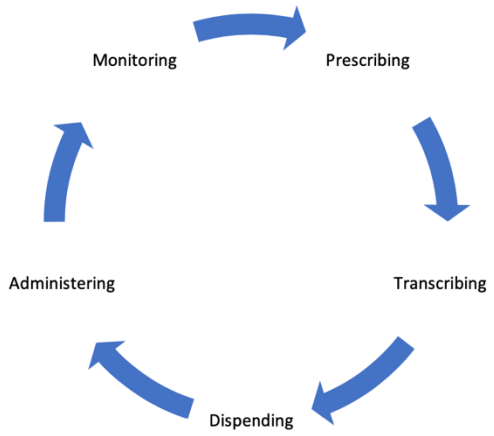

Figure 1.1 The Medication Process (Hughes & Blegen, 2007)

Tracking and reporting Medication Errors (ME) is fundamental to error prevention. The focus on MEs is centered on suggesting that preventable Adverse Drug Reactions (ADRS) in hospitals were among the five leading causes of death in hospitals as per the World Health Organization international safety goals (World Health Organization, 2017). Given how important, reliable, consistent, and safe patient care is to patients and their families. Therefore, hospitals should be committed to providing their patients with the safest patient care experience.

Electronic Medical Records (EMR) have aided health care workers in improving safety, still, to date there is no clear evidence about the effectiveness of the EMM System on improving patient's safety from a medication safety perspective.

The research about the statistical efficacy of EMM System on medication safety is indeterminant. Furthermore, opinions in the practice domain vary. It is believed that some are in favor of digitalizing the medication workflow to help

prevent harm to patients. In contrast, others believe that the stumbling block of over-alerting and alert fatigue will add to their work burden. Up to this date there is lack of research about the impact of electricizing the medication process and weighting the risks against the benefits of the digitalization.

1.2 Problem Statement

Evaluation studies to detect the benefit of a new systems are of great significance. Technology in the health domain is complex and costly. Hospitals must weigh the risks and benefits of electricizing healthcare processes prior reshaping the processes. When it comes to digitalizing an 'error prone' medication process, the digitalization might be problematic rather than solving problems. Today, most studies focus on the effect of (EMR)s on improving patient safety. However, we must weigh the specific benefits of electricizing the medication process and using an EMM System and its' safety outcomes. In Palestine, the studies about the impact of the EMR are limited. Regarding the EMM system, it was recently introduced in Palestine, thus this study will grant Palestinian hospitals statistical evidence about the impact of electricizing the medication cycle.

1.3 Research Significance

The findings of this study will provide statistical evidence about the impact of EMM Systems on medication safety and will be helpful to both healthcare providers and their patients. Moreover, this study will grant recommendations to the IAH about their new EMM System.

1.4 Objectives of the Study

i. The Study Aim

The aim is to study the impact of implementing the EMM System on medication safety. through studying physicians' compliance with complete medication orders at IAH.

ii. Specific Study Objectives

- To provide an accurate, up-to-date comparison between the paper-based medication prescription process and the electronic one.
- To identify the pattern of incompliance with the Complete Medication Order elements in the paper vs electronic system.

1.5 Research Hypothesis

To understand the impact of implementing the EMM system on improving medication safety, the following hypotheses will be constructed:

H0: There is no statistical significance between physicians' compliance with the 'Complete Medication Order' standard before and after the implementation of the Electronic Medication Management System ($P>0.05$).

1.6 Research Question

- Does the EMM system protect the patient identification through the medication process?
- Can the implementation of EMM system overcome the eligibility of the

medication order?

- Can the implementation of EMM system improve the physician's compliance with "Time, Dosage, Route of Administration'" Order Element documentation?

7.1 Research Expected Outcome

The use of an Electronic Medication System is one of the most promising applications of the EMR. It is expected to play a critical role in improving patient safety although minimizing harm to patients, reducing workflow errors, through increasing the system-wide efficiency. This research will provide statistical evidence about the impact of implementing EMM systems on medication documentation and provide evidence about its role in improving medication safety.

8.1 Outline Structure of the Thesis

The arrangements of this thesis appear in the following matters:

- **Chapter one** includes a study background, a problem statement, research significance, the general and specific objectives, research hypothesis, and expected research outcome.
- **Chapter two** includes an introduction to the Electronic Medical Records, an introduction to the Electronic Medication Management Systems, Medication Errors and Medication Safety, previous studies, variables, and the conceptual framework.
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- **Chapter three** includes research design, study tool and data collection, fieldwork, study settings, population and sample size, privacy and confidentiality, data analysis methods, ethical considerations, and study limitations.

- **Chapter four** includes the results, and the discussion are deliberated in this chapter.
- **Chapter five** includes the conclusion, recommendations, and future work.

CHAPTER TWO:

LITERATURE VIEW

2.1 Electronic Medical Records (EMR)

Ever since the introduction of (EMR) in healthcare, it has shown promising improvements in different domains in the care process. EMR enhances communication processes in healthcare facilities and establishes a strong foundation for the continuum of care. Alkureishi et al. (2016) explained that the successful implementation of EMR impacts communications between different healthcare providers and their relationship with their patients. According to Fritz et al. (2015), EMR can support all clinical work by providing accurate information to the intended personnel at the right time. For this reason, EMRs makes efficient use of the resources in hospitals, resulting in the reduction of medical errors (Fritz et al., 2015).

Discussions have been conducted over the technology's impact on hospital documentation from a continuity of care perspective. In 2011, research was conducted to compare the effective approach between the Electronic Medical Records and conventional paper approaches in the Emergency Department. The results indicate that both documentation and tracking of the patients' status were significantly improved when the EMR was used instead of the paper (Chan et al., 2011)

Furthermore, the information obtained from the EMR system allows proper management of the healthcare facilities. In 2016, a group of researchers conducted a study increasing the

operating room efficiency by conducting an Electronic Medical Record analysis. It was found out that utilizing EMR reporting tools help minimize scheduling inaccuracies. Analyzing data from the electronic records enables healthcare providers to detect operating room time scheduling errors and possible biases (Attaallah et al., 2016). Whereas in Canada, another research noted that the potential values of the EMR, such as improving productivity, enhancing care coordination, and providing patient safety, are being acknowledged in the healthcare domain (Lau et al., 2012).

2.2 Electronic Medication Management (EMM) Systems

EMM Systems have been introduced in healthcare facilities to help providers during the prescription process (Winata et al., 2021). Additionally, earlier research works indicate that EMM Systems are more effective and less expensive when compared to paper-based prescribing (Liu et al., 2013). Precisely, Westbrook et al. (2015) observed that EMM Systems are associated with increased effectiveness in reducing MEs. Similarly, Westbrook et al. (2013) found out that the implementation of the EMM System did not cause a redistribution of time away from direct care or towards medication tasks as it had been hypothesized, instead, it resulted in the reduction of the prescribing error rates in hospitals. For these reasons, the introduction of EMM System is helpful in contemporary care giving settings.

The implementation of EMM Systems helps in increasing medication safety by reducing transcription MEs. Lichtner et al. (2019) stated that EMM system helps in reducing patient safety issues during the care process. According to Callen et al. (2010), manual transcription of discharged medications is prone to multiple errors. Hartel et al. (2011) observed that the transcribing the process of drug orders manually from one paper sheet to another is a significant source of a medication error at the transcription phase of medical order. However, introducing an integrated EMM System in the EMR is strategic in reducing MEs by eliminating the transcription process (Callen et al., 2010; Hartel et al., 2011). In addition, Paans et al. (2010) suggested that EMR designers should develop systems that support clinicians to improve the accuracy of the medication order. Therefore, EMM Systems are significant in the transcription phase of the medical order in the contemporary digitized healthcare domain.

The EMM System improves clinicians' work efficiency and reduces prescription errors, but they are not perfect. According to Michael F. Furukawa (2011), implementation and the use of EMR can improve the healthcare provider's productivity, especially during visits for new medical conditions and routine chronic care. Additionally, Furukawa (2011) found out that electronic medical record systems help in providing real-time and remote access to the electronic patient chart in which both problem lists and medication history are contained, resulting in reduced MEs documentation. On the contrary, Redley & Botti (2013) observed that the introduction of EMM System is associated with different types of MEs compared to the traditional paper and pen documentation systems, such as generating *"human-*

machine inference errors" and other workflow related issues. In addition, the authors found out that electronic management systems can introduce issues worth consideration despite being beneficial in providing medication safety. Winata et al. (2021) support this finding by noting that EMM Systems does not address the risk of error problems and can introduce new error types.

2.3 Medication Errors and Medication Safety

MEs are public health problems, given that they affect a large number of patients, and although they are preventable, they can result in severe harm to patients (Dipiro et al., 2017). MEs can occur at any phase in the medication management process, from ordering to monitoring (Dipiro et al., 2017). For instance, prescribing MEs include incorrect drug selection, dosage, frequency, and duration (Dipiro et al., 2017). Any error during any phase in the medication management process can put the patient's safety in jeopardy. As a result, physicians face the difficult challenge of enhancing patients' safety (Aldosari, 2017; Harrington et al., 2011; Weant et al., 2014).

The prevalence of medication error occurrence in various steps of the medical order has resulted in the emergence of significant technological inventions and innovations in the healthcare industry. Nevertheless, many hospitals across the globe are introducing EMM Systems in their facilities to help reduce MEs for improved medication safety; thus, enhanced patient safety. Many regulatory agencies, such as the Joint Commission International (JCI) have shed light on patients' safety and medication safety in particular. Many

health care organizations compete to meet the JCI Standards and implement them in their organization's daily operations. Up to this date, around 1000 health institutes worldwide are currently JCI accredited (JCI | *Joint Commission International*, 2021). The JCI monitors compliance with its standards through various tools. Concerning the medical record standards, a Medical Record Review tool is used to assess the appropriateness and comprehensiveness of the medical record data. The JCI monitoring tool aims to increase patient care to improve medication safety in the contemporary technological era. According to Lazaryan et al., (2016), their study showed that following the JCI standards remotely, they had a considerable effect in reducing medication incidents and thus improving patient safety. Apart from being recognized internationally as the gold standard for international evaluation, JCI standards have gained global acceptance as an effective quality evaluation and management tool (Day et al., 2013).

According to Gozlu K & Kaya S (2016), JCI accreditation increases patient safety by increasing providers' awareness of potential MEs and preventing their possible recurrence.

As mentioned before, MEs can occur at different phases of the medical order, such as during the prescribing, transcribing, administration, and monitoring stages (Wang et al., 2015). Wang et al. (2015) found out that JCI advocates medication error prevention despite the lack of reports on the experience in reducing medication administration errors during the period before and after its accreditation. Therefore, it is justifiable to use the JCI tool when conducting a comparative study between the impact of the EMM System

and traditional paper documentation on medication and patient safety from the reduction of MEs perspective.

Abbass et al. (2011) conducted retrospective research on the impact and determinants of computerized prescriber order entry on the medication administration process. The authors recorded 10.5% MEs in paper-based orders reviewed compared to only 1.6% in the computerized prescriber order entry. According to the study, incorrect doses, wrong administration frequency, inappropriate abbreviations, and occurrence of allergy were the most prevalent MEs in the traditional paper documentation systems. Similarly, incorrect doses and allergy occurrences were the most prevalent errors in the computerized prescriber order entry despite the system having drug interaction errors (Abbass et al., 2011). In addition, the authors found out that the computerized prescriber order entry resulted in a 50% reduction in medication order turnaround time. One of the significant determinants of the medication order turnaround time were potential MEs, implementation of the system, unidentified prescribers, and urgency of the medication order. Therefore, the findings from this study can be used to conclude that the implementation of a commercial computerized prescriber order entry system helps reduce MEs and enhance medication order turnaround times.

While investigating the impact of computerized provider order entry on MEs in multispecialty group practice, Devine et al. (2010) found out that the frequency of errors declined from 18.2% to 8.2%., the largest reduction occurred in the adjusted odds of error of illegibility, use of inappropriate abbreviations, and missing information. Nonetheless, a 57% reductions in adjusted odds were

not harmful. Moreover, the few errors recorded in the preventable ADRS lowered the significance of the reduction in the number of errors that caused harm during the study. Based on these findings, it can be concluded that a basic system in a hospital has a significant influence on the reduction in MEs.

2.1 Variables and Conceptual Framework

Figure 2.1 shows the conceptual framework of the study. The conceptual framework developed for the study was built based on findings from previous studies, the proposed effect of implementing an EMM system, and the variables used to assess the effect.

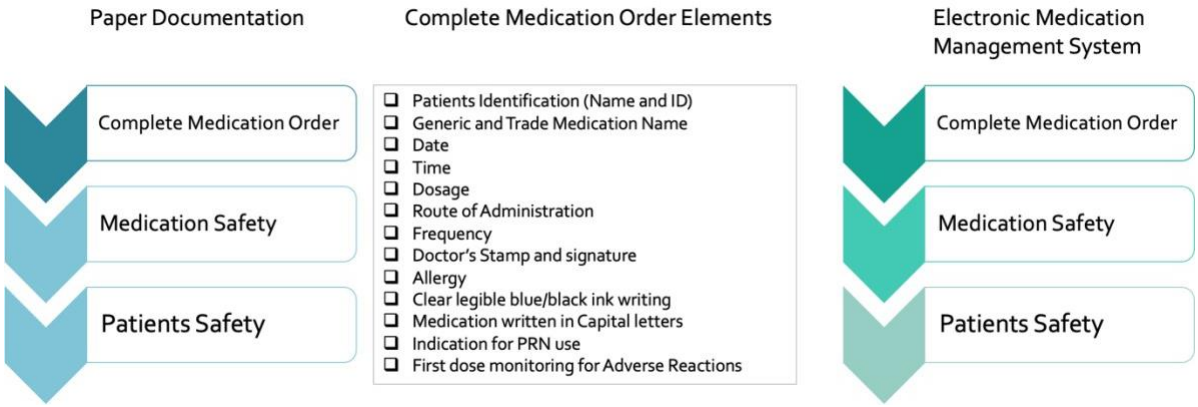


Figure 2.1 Conceptual and Theoretical Framework of the study

The researchers developed the framework map based on the broad concept of patient safety, which is difficult to measure. In this research, the researcher will focus on the medication safety concept as a tool to measure patient safety. The literature showed that a high number of incidents happen through the prescribing process during the medication cycle (Wittich et al., 2014). The researcher will

measure medication safety through measuring compliance by documenting a complete medication order during the prescribing process.

There is one variable (control) related to patient safety and that is 'complete medication order'. Besides, there are thirteen variables (independent) in the medication order: Patients Identification (Name and ID), Generic and Trade Medication Name, Date, Time, Dosage, Route of Administration, Frequency, Doctor's stamp and signature, allergy, legibility, Medication written in Capital letters, Indication for Pro Re Nata (PRN) use, and First dose monitoring for Adverse Reactions.

In this research, the researcher will examine the impact of implementing the EMM system as a tool to improve compliance to medication documentation and improve medication safety and hence patient safety.

Operational definition of variables:

Complete Medication Order:

A complete medical order would have all following components:

- Patients Identification (Name and ID)
- Generic and Trade Medication Name
- Date
- Time
- Dosage
- Route of Administration
- Frequency

- Doctor's Stamp and signature
- Allergy
- Medication written in capital letters
- Indication for Pro Re Nata (PRN) use
- First dose monitoring for Adverse Reactions within one hour of administration

Medication safety:

"The freedom from accidental injury due to medical care or medical errors during the medication use process." (Saine & Larson, 2006). Medication safety is reflected and measured through medication, ADRS and MEs.

Patients' safety:

"the absence of preventable harm to a patient during the process of health care, including the reduction of the risk of unnecessary harm associated with health care to an acceptable minimum." (World Health Organization, 2017) Patients' safety can be reflected through medical errors and incidents.

2.2 Summary of Chapter Two

This chapter includes an overview of the literature review of the EMR and the value it showed in the hospital setting. Additionally, the EMM System was discussed and how it contributed to medication safety. Finally, the conceptual framework and previous research studies were deliberated.

CHAPTER THREE:

METHODOLOGY

3.1 Introduction

In this chapter, the researcher displays the study design, study tools and data collection, fieldwork, study settings, phases, population and sample size, privacy and confidentiality, data analysis methods, ethical consideration, and study limitations.

3.2 Research Design

It is Non-Experimental Pre and Posttest design. The study's design used a quantitative analysis approach using an open chart review methodology (retrospective study) to determine the impact of implementing the EMM System on medication safety. The study was conducted over five months in different hospital departments. At first, data was gathered from paper medical files and the Kardex from different departments over two months, as shown in Appendix A and Appendix B. and then, data was gathered from the same departments using the EMR over three months, as in Appendix C. The results were compared and contrasted to see the effect of implementing EMM system versus paper documentation.

3.3 Study Tools and Data Collection

The researchers used an international valid and reliable tool for data collection "Complete Medication Order" monitoring tool, which is derived from The Joint Commission International (JCI) Medical Record Review Tool. All JCI accredited

hospitals use the tool formedication management worldwide. Among the one thousand accredited hospitals in the world, there are four accredited hospitals in Palestine (*JCI | Joint Commission International*, 2021).

JCI accredited hospitals use this international tool to monitor healthcare compliance with the documentation standards in the medical record. Specifically, the medication order documentation is monitored through the "Complete Medication Order" tool. Our research will use this tool to focus on monitoring the complete doctor order and medication documentation. It is applied for paper orders and electronic orders (see Appendix D).

3.4 Fieldwork

This research has been conducted in two phases as mentioned below:

Phase One: In November and December 2019, IAH relied on the Kardex (medication administration paper record) to document the medication order. During this period, the researchers used the study tool to collect data from the medical file papers and to reflect on the physicians' compliance with the 'complete medication order' elements.

Phase Two: In January, February, and March 2020, the hospital started using the EMM System for documenting the physicians' orders and tracing the medication order. During the whole study period, the researchers used the same tool to reflect on the physicians' compliance in medication documentation during the whole study setting.

3.5 Study Setting

This study occurred at IAH, Al Rayhaan, Ramallah; a major referral hospital for West Bank and Gaza Strip residents, providing a wide range of general and specialized clinical services in different departments. The hospital licenses 210 beds and employs 520 employees. In this study,

The following departments were included; medical oncology, pediatrics, pediatric, adult and neonate intensive care units, medical, surgical, orthopedic, postnatal, medium, and cardiac care units were included in our study setting.

3.6 Population and Sample Size

The population of the study was all admitted patients who exceeded 48 hours on their admission from different hospital departments. The targeted population involved all admitted patients for more than two days between the 15th to 25th of each month, over five consecutive months (November/2019 – March/2020). All studied medical files were randomly selected from the mentioned before hospital department. The sample size was two hundred and six orders. The paper medication order samples were equal to sixty-five which were collected during November 2019 and December 2019. The total number of medication orders collected during the electronic phase was equal to one hundred forty-one, which were collected during January 2020, February 2020, and March 2020.

Inclusion criteria:

Admitted Patients' medical files who are two days of their admission from the mentioned departments.

Exclusion criteria:

All physicians' orders given in the emergency room, labor, outpatient clinics, and daycare, oncology, and operating room. Patients less than two days' admission and outpatient medical files were also excluded from the sample.

3.7 Privacy and Confidentiality

The researcher guaranteed confidentiality by assuring that the information was not available for anyone involved in the study and the data was kept in locked private computers. The patient and healthcare provider names were not required or documented. The collected data was kept at the researcher's desktop and secured by a password.

3.8 Method of Data Analysis

With the help of a statistician, the data was analyzed using the Statistical Package for Social Sciences (SPSS version 22.0). The data was analyzed with the following statistical tools: descriptive analysis and parametric tests (independent t-test). The descriptive analysis was used to identify the 'complete medication order' compliance in documentation, and the results were used to compare the paper and the electronic documentation. The descriptive analysis was also used to reflect on the medication order elements frequencies, and the patterns in compliance between the paper and the electronic documentation. The Independent t-test was used to identify whether the electronic system had a statistical impact on the compliance with a 'complete medication order' documentation. The same test was used on specific order elements to identify the statistical impact of the new system on the

specific order elements.

3.9 Ethical Consideration

Ethical approval from Arab American University was obtained. The approval from IAH ethics committee and administration was obtained, as shown in Appendix E.

3.10 Study Limitations

- This study was conducted two months before implementing the EMM System, until three months after the implementation. By this, the study did not consider the learning period in which physicians might have needed to adapt and adjust to the new system. This may have affected the results of the post-implementation phase.
- As the EMM System is newly implemented, the physicians might have faced technical limitations. As a result, technical support might have been limited when support was needed.
- Attitudinal constraints behavior of healthcare providers toward the new information system and their fear of work disruption might have contributed negatively to the results of this study. People are resistant to change, so some healthcare providers might have had a negative behavior toward the new system, and thus affected the study.
- This retrospective study has investigated whether the new system has improved the physicians' compliance towards a complete medication order. However, it has not examined the causality of the noncompliance, which might have contributed to our understanding of the results of the study.

- Generalization of the study findings might be limited.

3.1 Summary of Chapter Three

In this chapter, the researcher displayed the study design, setting, and tool used to conduct this research. The population and sample size were elaborated, and a description of the data collection phases was discussed. And finally, the study limitations and ethical considerations.

CHAPTER FOUR:

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the results of studying the use of EMM System versus the Traditional Paper Approach are shown. The first part includes the physicians' compliance with writing a complete medication order through the Traditional Paper Approach using the percentage of compliance. The second part includes the compliance of the physicians with a complete medication order using the EMM System. The third part includes comparing findings between both systems by using the t-test for the overall findings and for each item in the tool. In the fourth part, the study hypothesis is discussed. Finally, a discussion of the results is shown.

4.2 Traditional Paper Approach

The total number of paper doctor orders were sixty-five orders, collected in November 2019 and December 2019. The doctors' medications' order compliance with the complete medication order, through using Traditional Paper Approach was 70.5% as shown in Table 4.1. The percentage of compliance for each item of Monitoring Tool for Complete Medication Order were as the following: 95.4% for (patient name, patient ID, and national ID), 95.4% for name of medicine (generic and trade) ,95.4% for date of medications, 95.4% for time of medications ,89.2% for dosage of medications, 87.7% for route of administration, 87.7% for frequency of medications, 90.8% for Doctor's stamp and signature, 3.1% for allergy of foods and drugs,

93.8% of clear legible writing, 72.3% of medication is written in capital letters, 10.8% of the indication for PRN use is mentioned, and the percentage of monitoring of the first dose including documented Adverse reaction equals 0% as shown in Table 4.1.

Table 4.1: Compliance with Complete Medication Order documentation through Using Paper Approach. Compliance with Complete Medication Order documentation through Using Paper Approach.

#	**Item**	**YES**	**NO**	**NA**	**Total**
1	Patient Name, Patient ID and National ID.	62	1	2	65
		95.4%	1.5%	3.1%	100%
2	Name of medicine (Generic and Trade)	62	1	2	65
		95.4%	1.5%	3.1%	100%
3	Date	62	1	2	65
		95.4%	1.5%	3.1%	100%
4	Time	62	1	2	65
		95.4%	1.5%	3.1%	100%
5	Dosage	58	5	2	65
		89.2%	7.7%	3.1%	100%
6	Route of administration	57	6	2	65
		87.7%	9.2%	3.1%	100%
7	Frequency	57	6	2	65
		87.7%	9.2%	3.1%	100%
8	Doctor's stamp & signature	59	4	2	65
		90.8%	6.2%	3.1%	100%
9	Allergy	2	9	54	65
		3.1%	13.8%	83.1%	100%
10	Clear legible handwriting	61	2	2	65
		93.8%	3.1%	3.1%	100%
11	The medication is written in capital letters	47	16	2	65
		72.3%	24.6%	3.1%	100%
12	The indication for PRN use is mentioned	7	19	39	65
		10.8%	29.2%	60.0%	100%
13	Monitoring first dose including documentation for Adverse reaction	0	0	65	65
		0.0%	0.0%	100.0%	100%
Total		**70.5%**	**8.4%**	**21.1%**	**100%**

4.3 Electronic Medication Management System

The total number of studied samples were one hundred forty-one, collected in January 2020, February 2020, and March 2020. The compliance with the complete medication order through using EMM System was 78% as shown in Table 4.2. The percentage of compliance for each item of Monitoring Tool for Complete Medication Order were as the following:100 % for patient name, patient ID, and national ID, 97.9 % for name of medicine (generic and trade) ,100 % for date of medication ,100 % for time of medication, 96.5 % for dosage of medications, 96.5 % for route of administration ,96.5 % for frequency of medications, 100% for Doctor's stamp and signature, 15.6% for allergy of foods and drugs,100% for legible writing, 90.1% of medication is written in capital letters, 19.1% of the indication for PRN use is mentioned and the percentage of monitoring of the first dose including documented for Adverse reaction equal 0% as shown in Table 4.2

Table 4.2: Compliance with Complete Medication Order documentation through Using EMM System.

#	**Item**	**YES**	**NO**	**NA**	**Total**
1	Patient Name, Patient ID and National ID.	141	0	0	141
		100.0%	0.0%	0.0%	100%
2	Name of medicine (Generic and Trade)	138	3	0	141
		97.9%	2.1%	0.0%	100%
3	Date	141	0	0	141
		100.0%	0.0%	0.0%	100%
4	Time	141	0	0	141
		100.0%	0.0%	0.0%	100%
5	Dosage	136	5	0	141
		96.5%	3.5%	0.0%	100%

6	Route of administration	136	5	0	141
		96.5%	3.5%	0.0%	100%
7	Frequency	136	5	0	141
		96.5%	3.5%	0.0%	100%
8	Doctor's stamp & signature	132	9	0	141
		93.6%	6.4%	0.0%	100%
9	Allergy	22	4	115	141
		15.6%	2.8%	81.6%	100%
10	Clear legible writing	141	0	0	141
		100%	0.0%	0.0%	100%
11	The medication is written in capital letters	127	14	0	141
		90.1%	9.9%	0.0%	100%
12	The indication for PRN use is mentioned	27	42	72	141
		19.1%	29.8%	51.1%	100%
13	Monitoring first dose including documented for Adverse reaction	0	0	141	141
		0.0%	0.0%	100.0%	100%
Total		**78%**	**4.1%**	**17.9%**	**100%**

4.4 Descriptive Statistics - Comparison Between the Two Approaches; Electronic Medication Management System and the Traditional Paper Approach.

According to Figure 4.1 below, the total compliance of a complete medication order increased with using EMM System. The compliance to complete the medication order while using the paper form: 70.5%, while the compliance while using the EMM system increased to 78%.

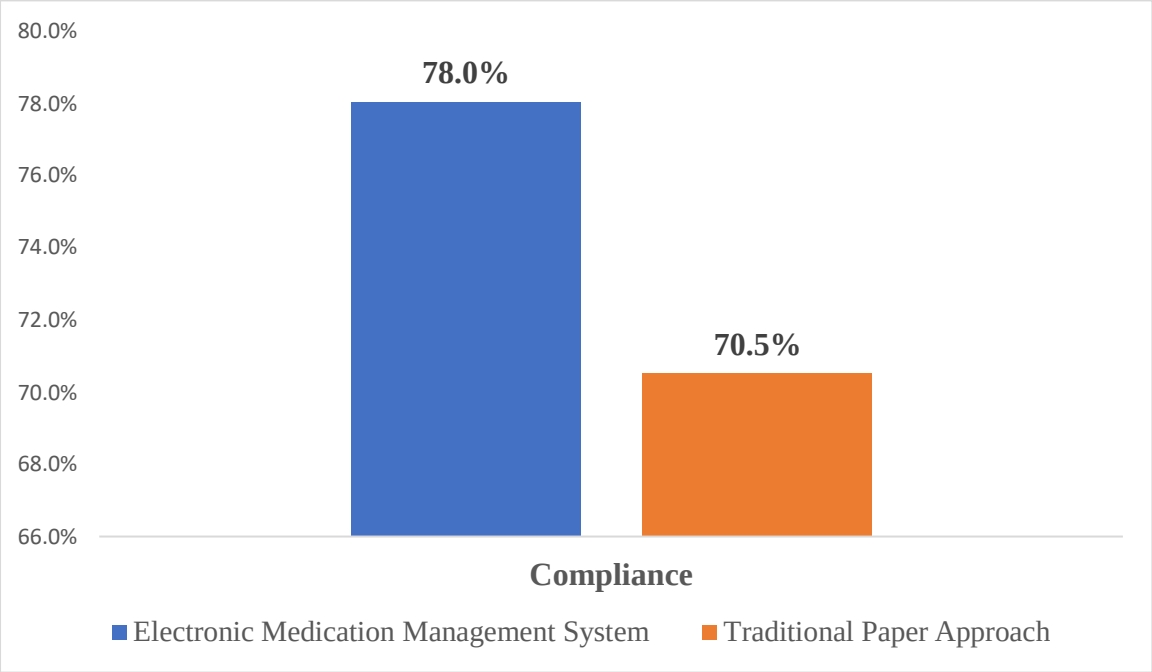


Figure 4.1: The Total Compliance with 'Complete Medication Order' between the paper and the electronic documentation.

4.4.1 Patient Name, Patient ID and National ID

According to Figure 4.2 below, the compliance with a complete documentation of Patient Name, Patient ID, and National ID increased with using EMM System. The compliance with Patient Name, ID and National ID order elements in the paper forms was 95.4%. While the compliance of the EMM system with the same order element was 100%.

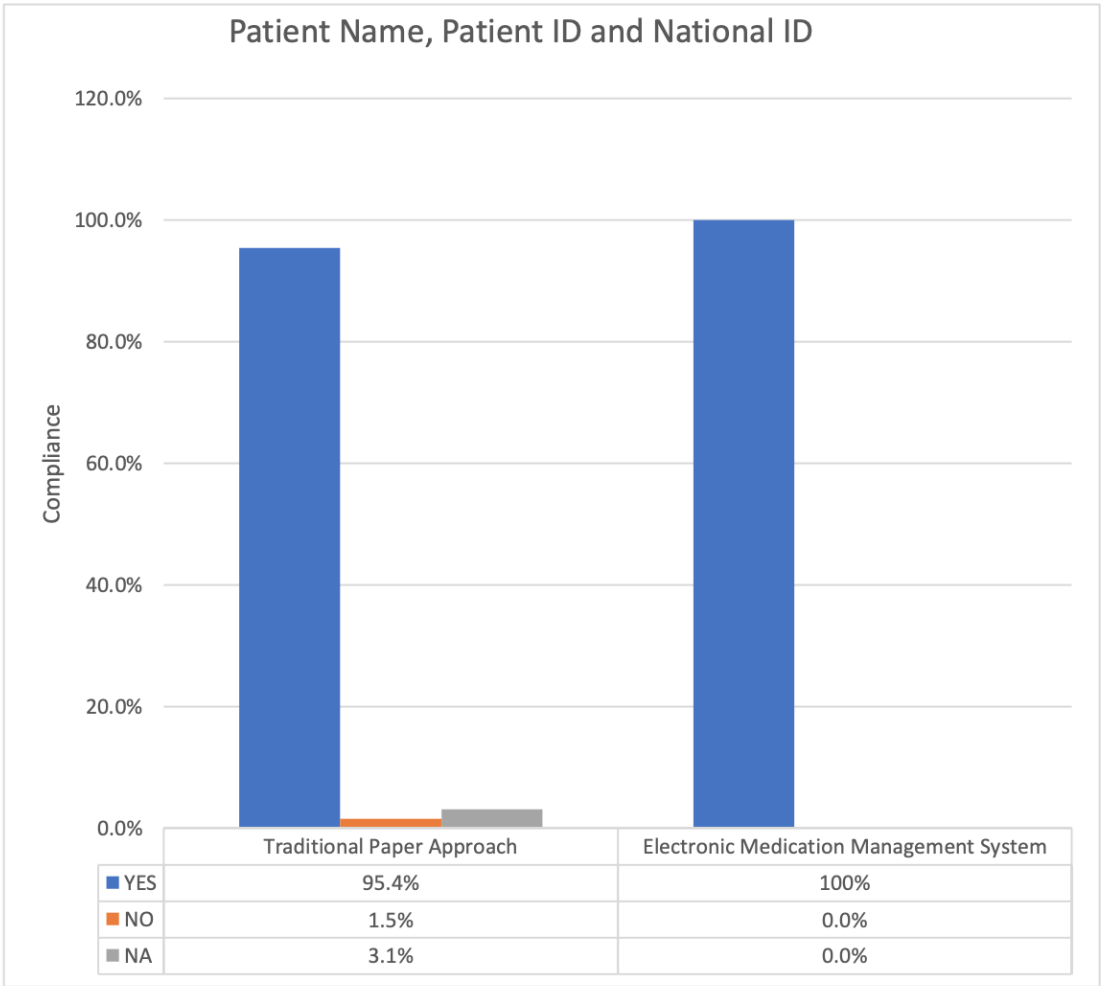


Figure 4.2: Total compliance with Patient Name, Patient ID and National ID Order Elements between the paper and electronic documentation

4.4.2 Name of medicine (Generic and Trade)

According to Figure 4.3 below, the compliance with a complete documentation of Names of medicine (Generic and Trade) increased with using EMM System. The compliance with Name of medicine (Generic and Trade) order element in the paper forms was 95.4%. While the compliance of the EMM system with the same order element was 97.9%.

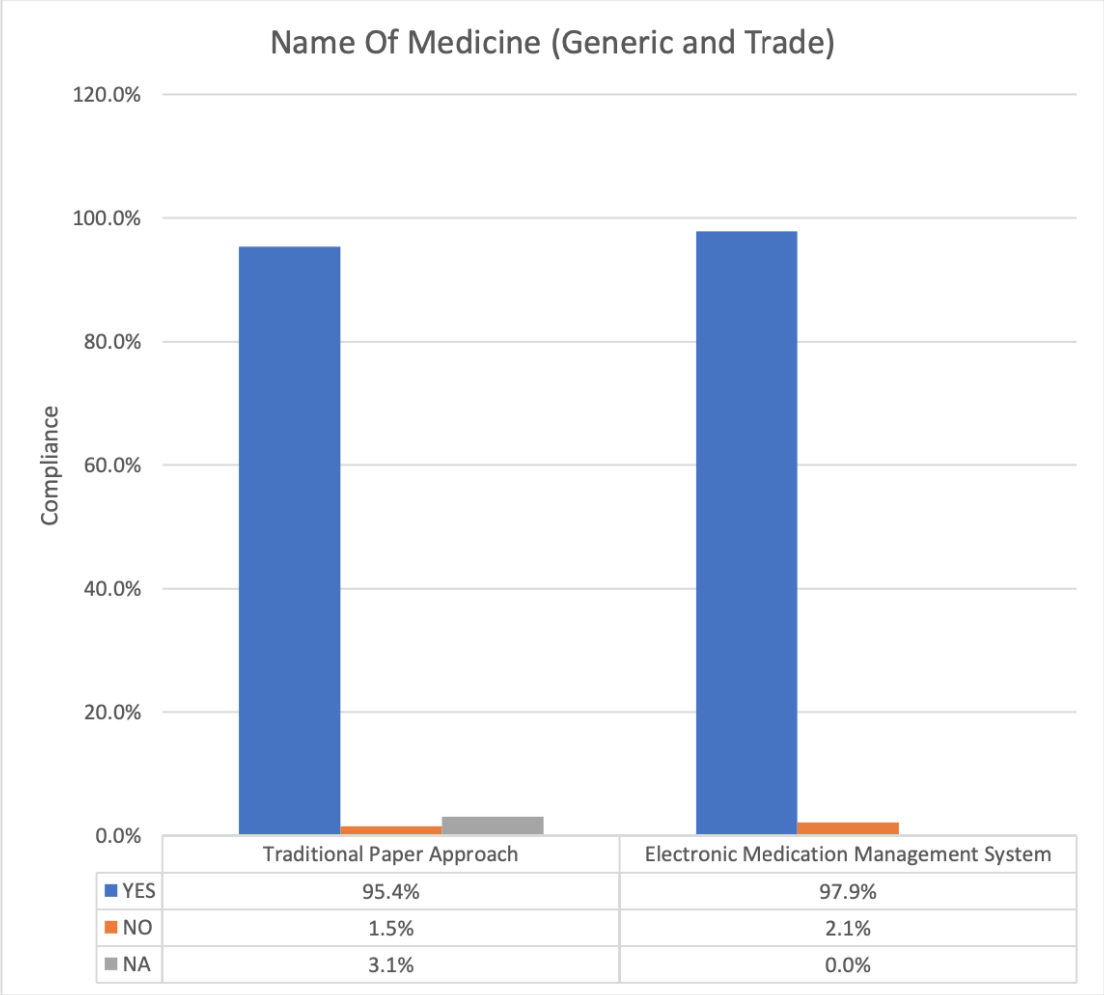


Figure 4.3: Total compliance with (Name of Medicine) Order Element between the paper and electronic documentation

4.4.3 Date

According to Figure 4.4 below, the compliance with a complete documentation of Date increased with using EMM System. The compliance with Date order element in the paper forms was 95.4%. While the compliance in the EMM system to the same order element was 100%.

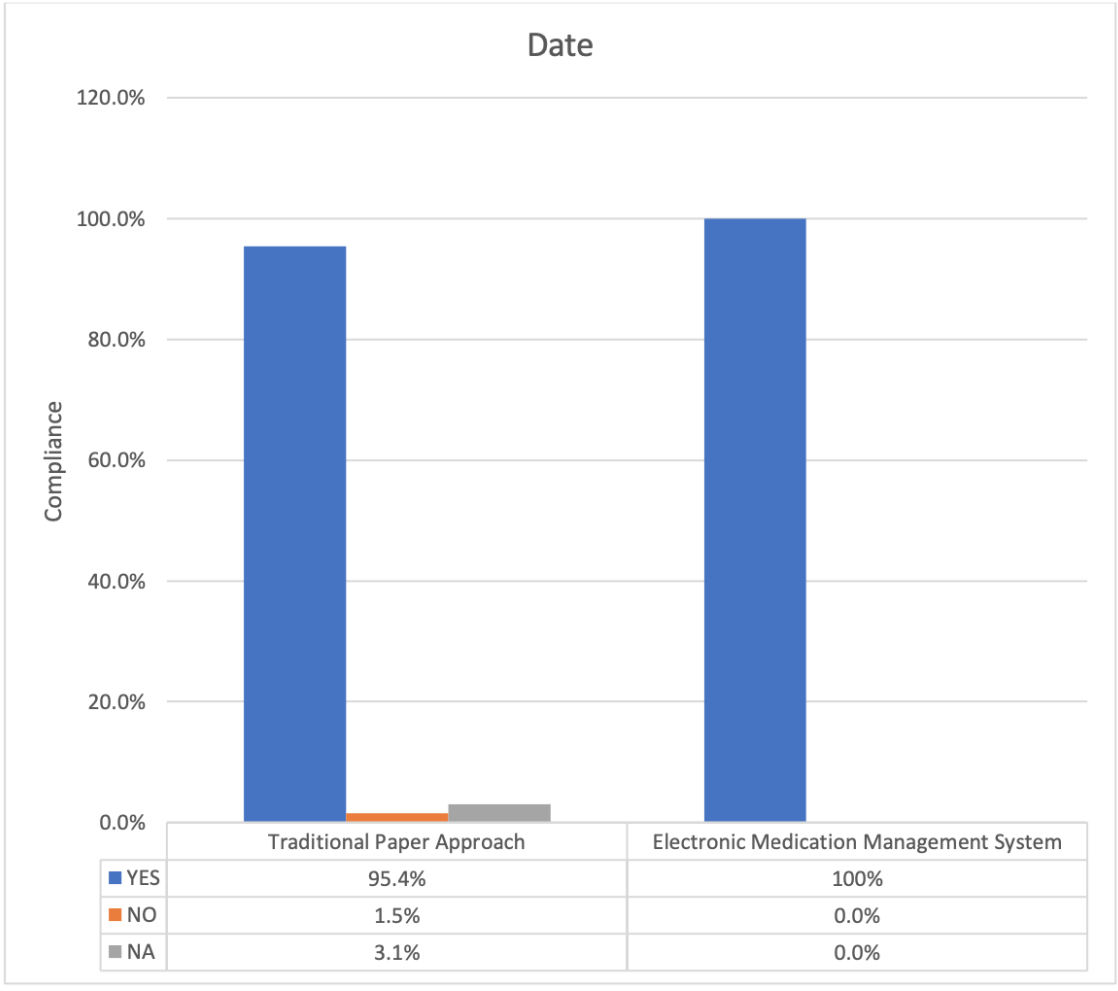


Figure 4.4: Total compliance with Date Order Elements between the paper and electronic documentation

4.4.4 Time

According to Figure 4.5 below, the compliance with complete documentation of Time increased with using EMM System. The compliance with time order element in the paper forms was 95.4%. While the compliance of the EMM system with the same order element was 100%.

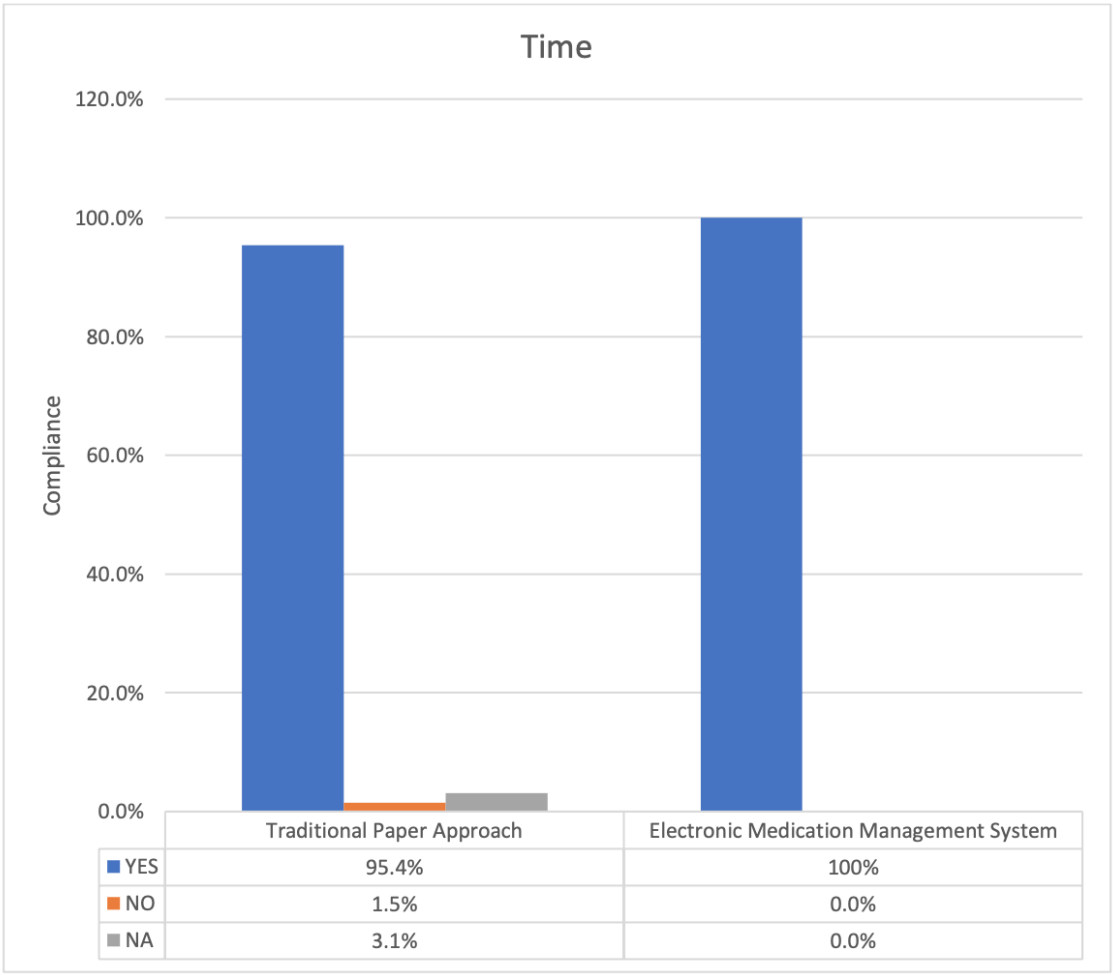


Figure 4.5: Total compliance with Time Order Element between the paper and electronic documentation

4.4.5 Dosage

According to Figure 4.6 below, the compliance with a complete documentation of Dosage increased with using EMM System. The compliance with dosage order element in the paper forms was 89.2%. While the compliance in the EMM system to the same order element was 96.5%.

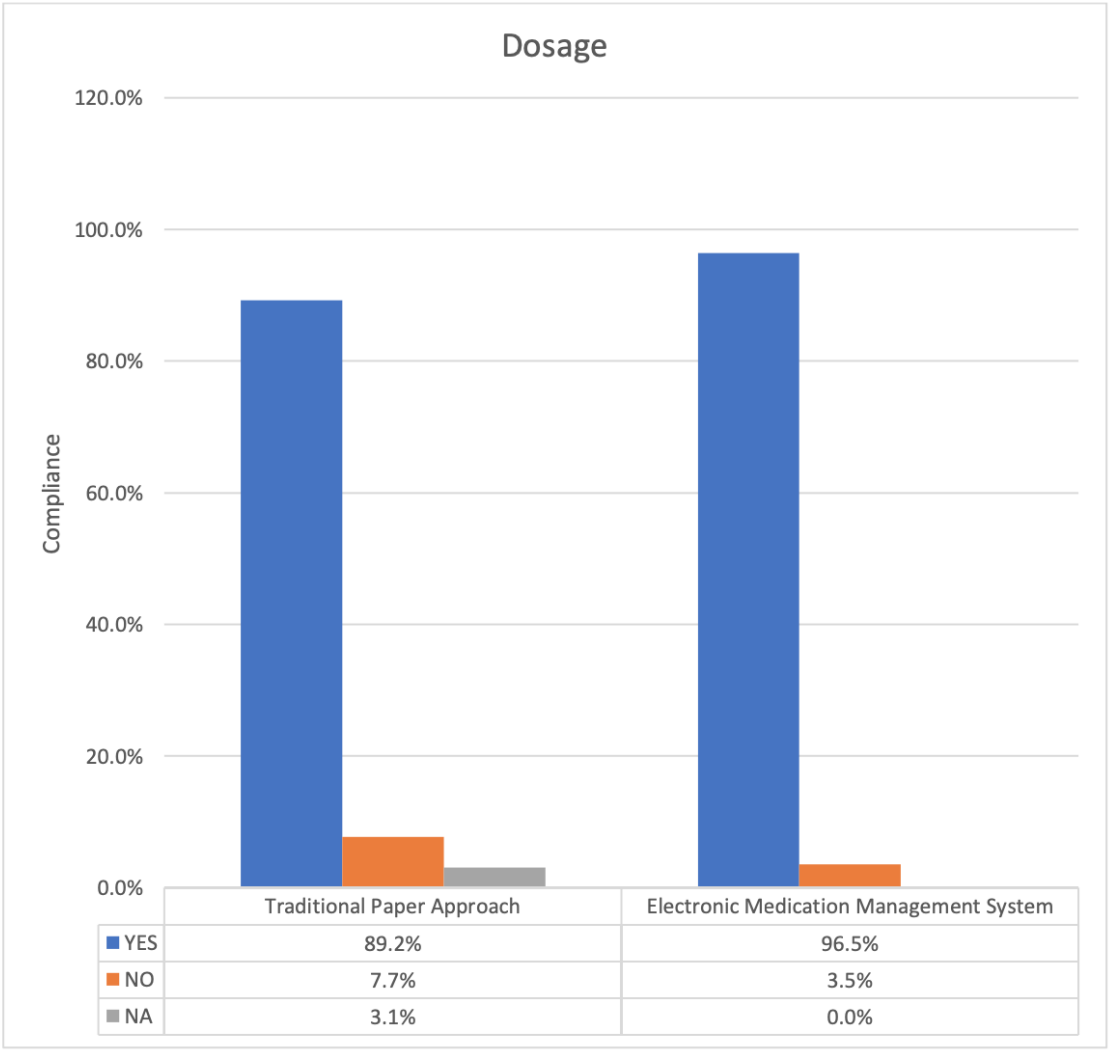


Figure 4.6: Total compliance with Dosage Order Elements between the paper and electronic documentation

4.4.6 Route of Administration

According to Figure 4.7 below, the compliance with a complete documentation of Route of Administration increased with using EMM System. The compliance with Route of Administration order element in the paper forms was 87.7%. While the compliance of the EMM system with the same order element was 96.5%.

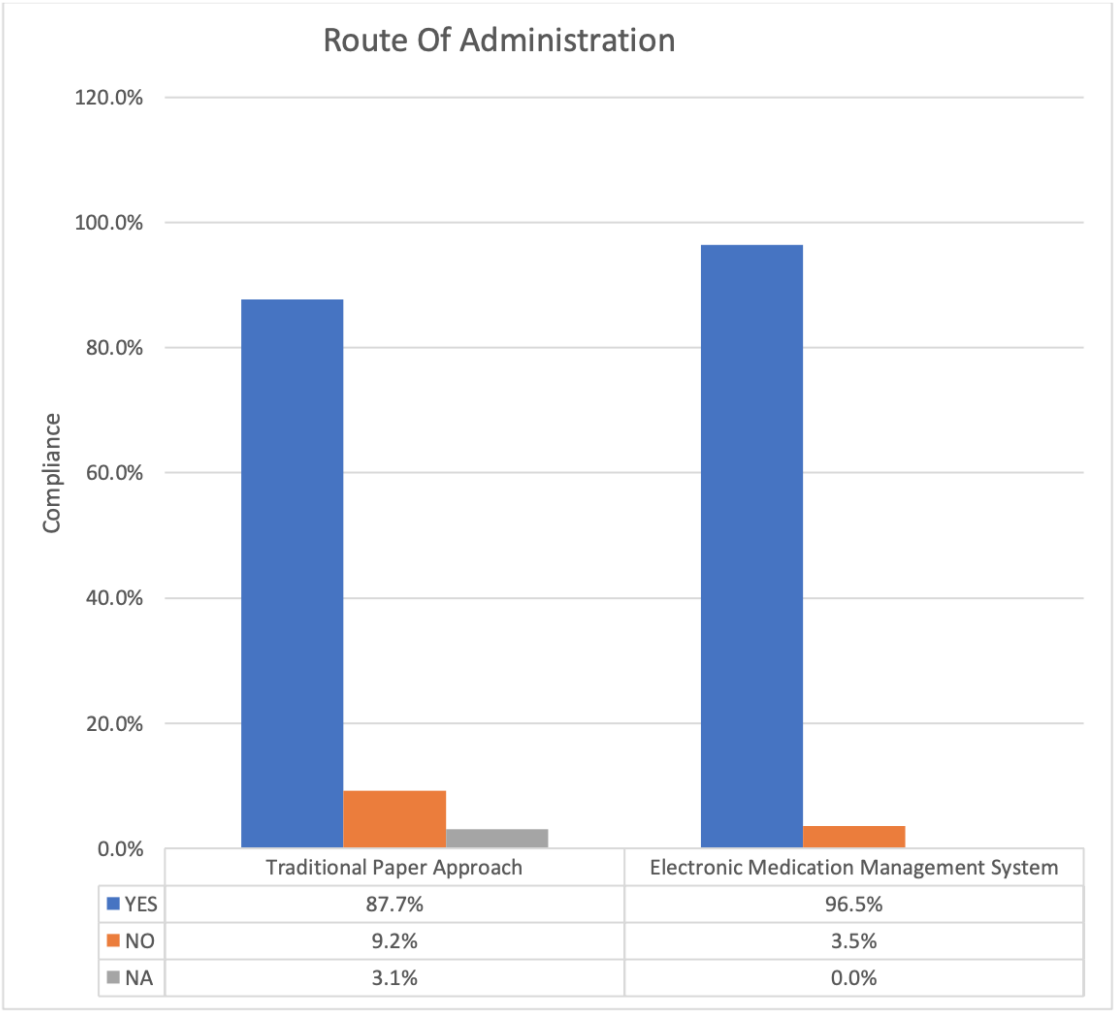


Figure 4.7: Total compliance with Route of Administration Order Element between the paper and electronic documentation

4.4.7 Frequency

According to Figure 4.8 below, the compliance with a complete documentation of Frequency increased with using EMM System. The compliance of frequency order element in the paper forms was 87.7%. While the compliance of the EMM system with the same order element was 96.5%.

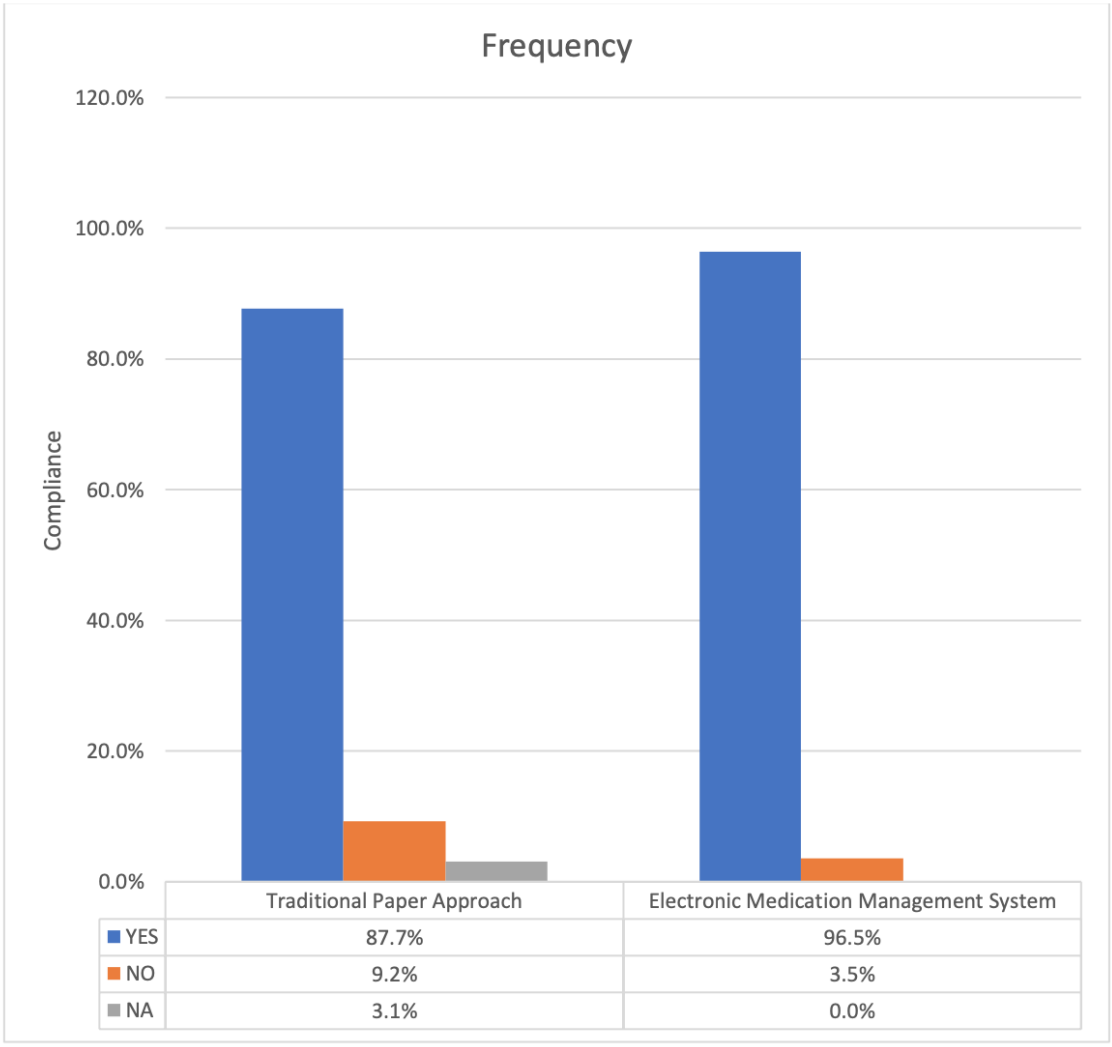


Figure 4.8: Total compliance with Frequency Order Elements between the paper and electronic documentation

4.4.8 Doctor's stamp & Signature

According to Figure 4.9 below, the compliance with Doctor's stamp and Signature order element increased with using EMM System. The compliance of the paper forms was 90.8%. While the compliance of the EMM system with the same order element was 100%.

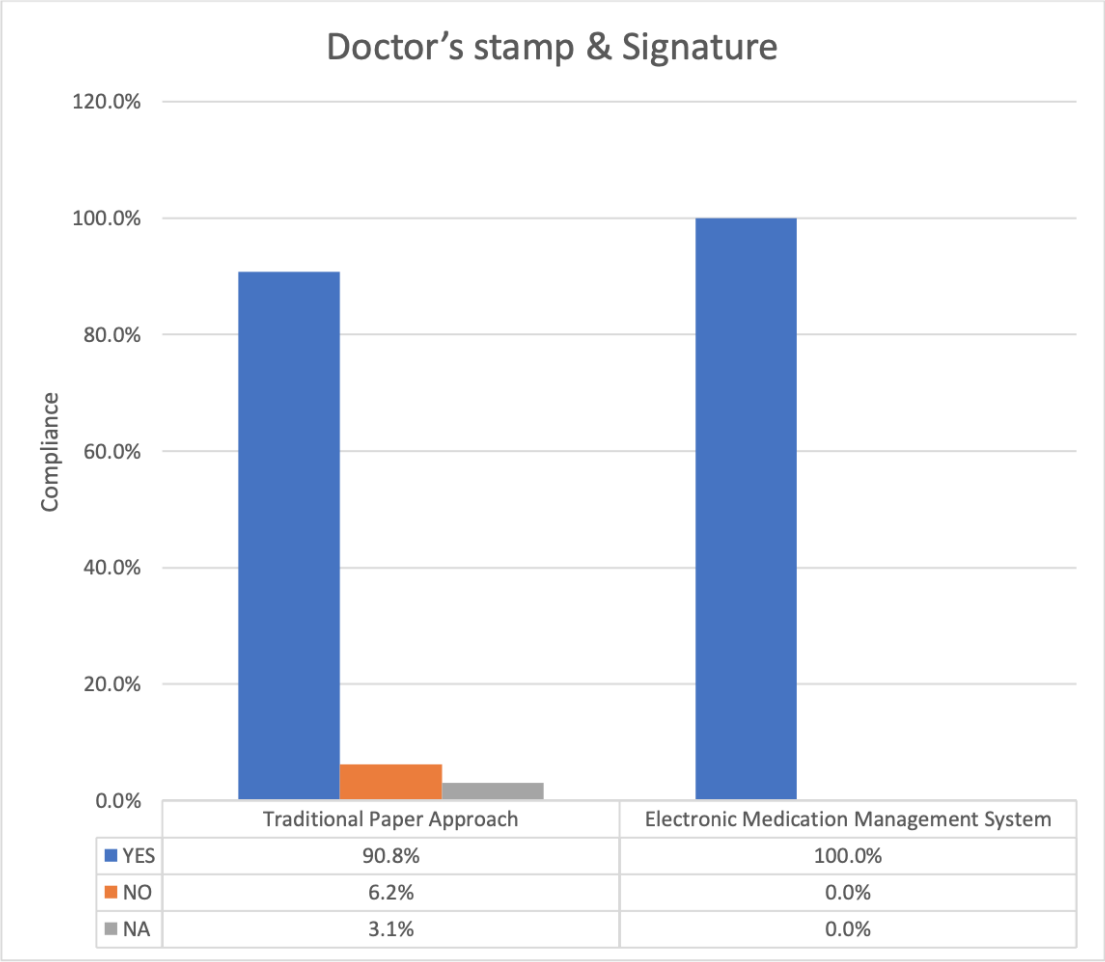


Figure 4.9: Total compliance with Doctor's Stamp and Signature Order Element between the paper and electronic documentation

4.4.9 Allergy

According to Figure 4.10 below, the compliance with Allergy documentation increased with using EMM System. The compliance of the paper forms was 3.1%. While the compliance of the EMM system with the same order element was 15.6%.

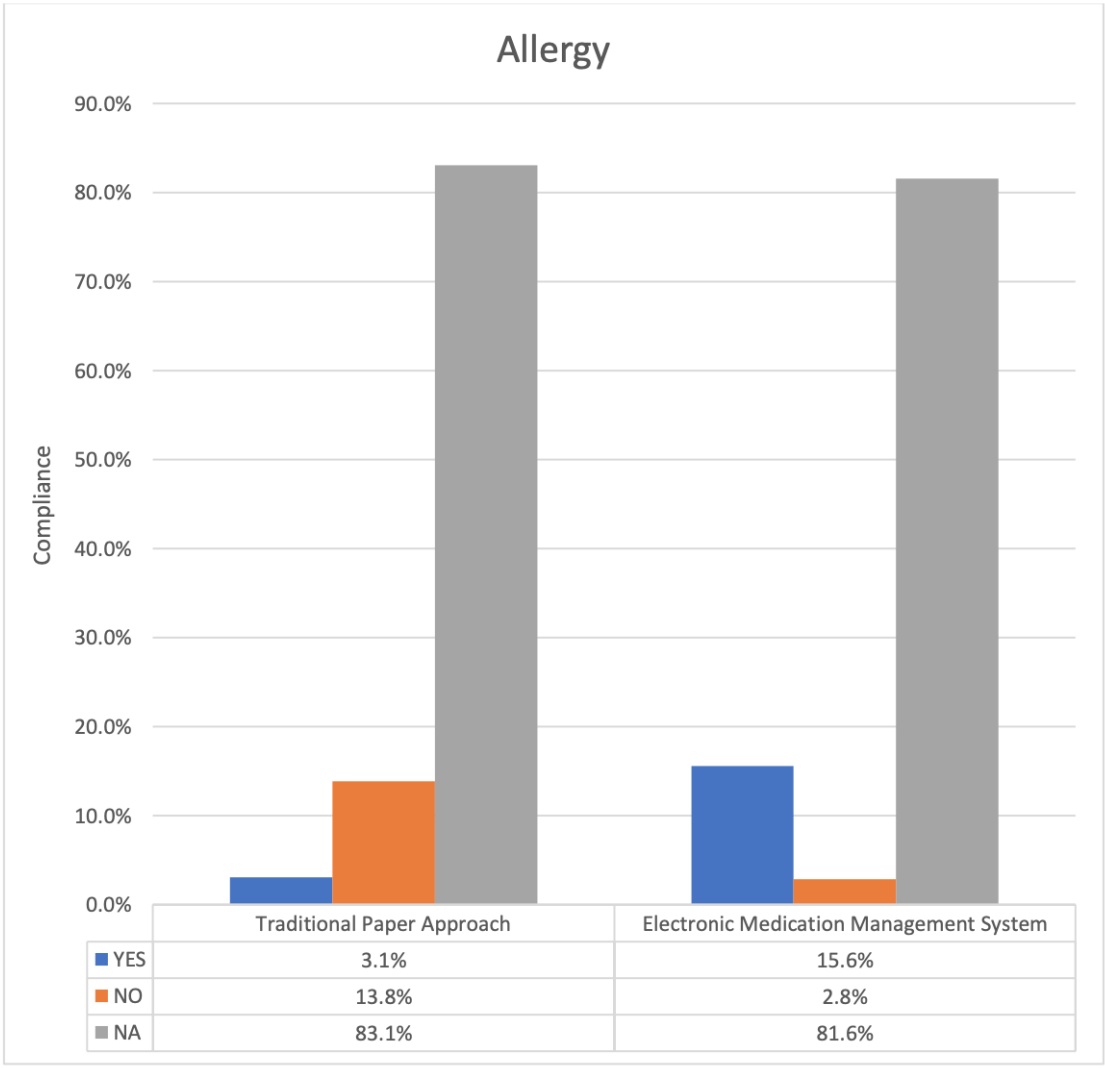


Figure 3.10: Total compliance with Allergy documentation between the paper and electronic documentation

4.4.11 Clear legible Writing

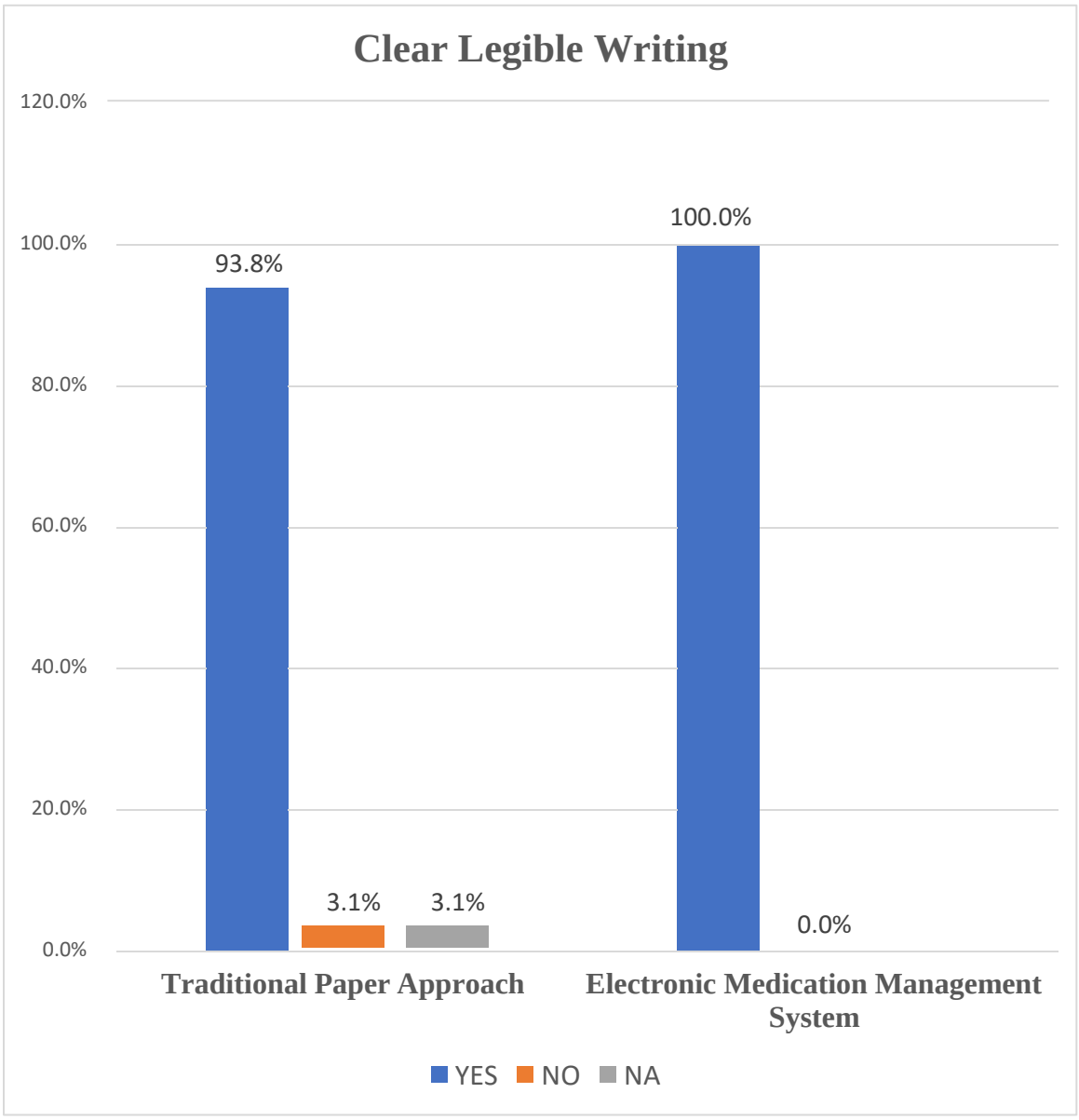


Figure 4.11: Total compliance with clear legible writing between the paper and electronic documentation

4.4.12 Writing medication in capital letters

According to Figure 4.12 below, the compliance with writing the medication in capital letters increased with using EMM System. The compliance of the paper forms was 72.3%. While the compliance of the EMM system with the same order element was 90.1%.

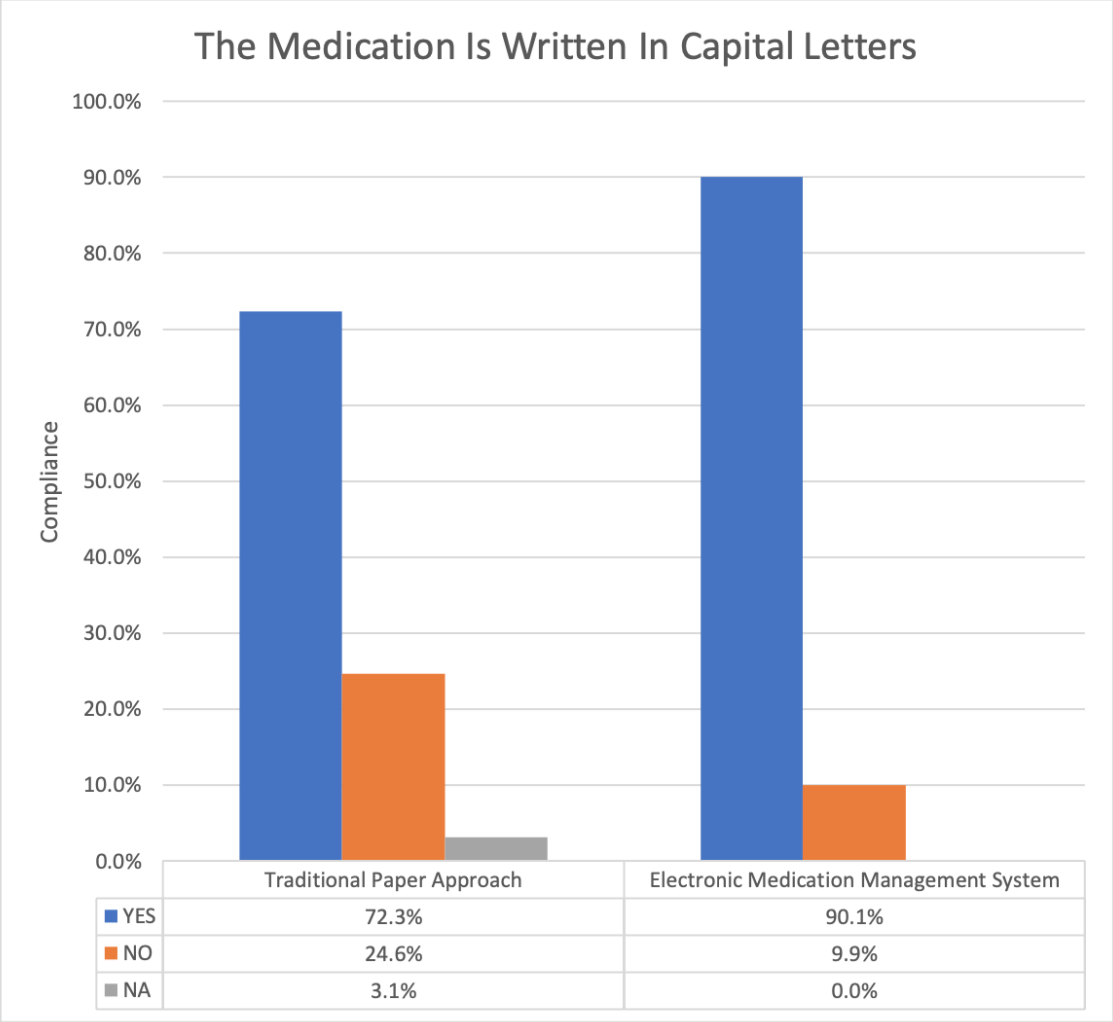


Figure 4.12: Total compliance with writing medication in capital letters between the paper and electronic documentation

4.4.13 Indication for PRN use documentation

According to Figure 4.13 below, the compliance with documenting the indication for PRN use increased with using EMM System. The compliance of the paper forms was 10.8%. While the compliance of the EMM system with the same order element was 19.1%.

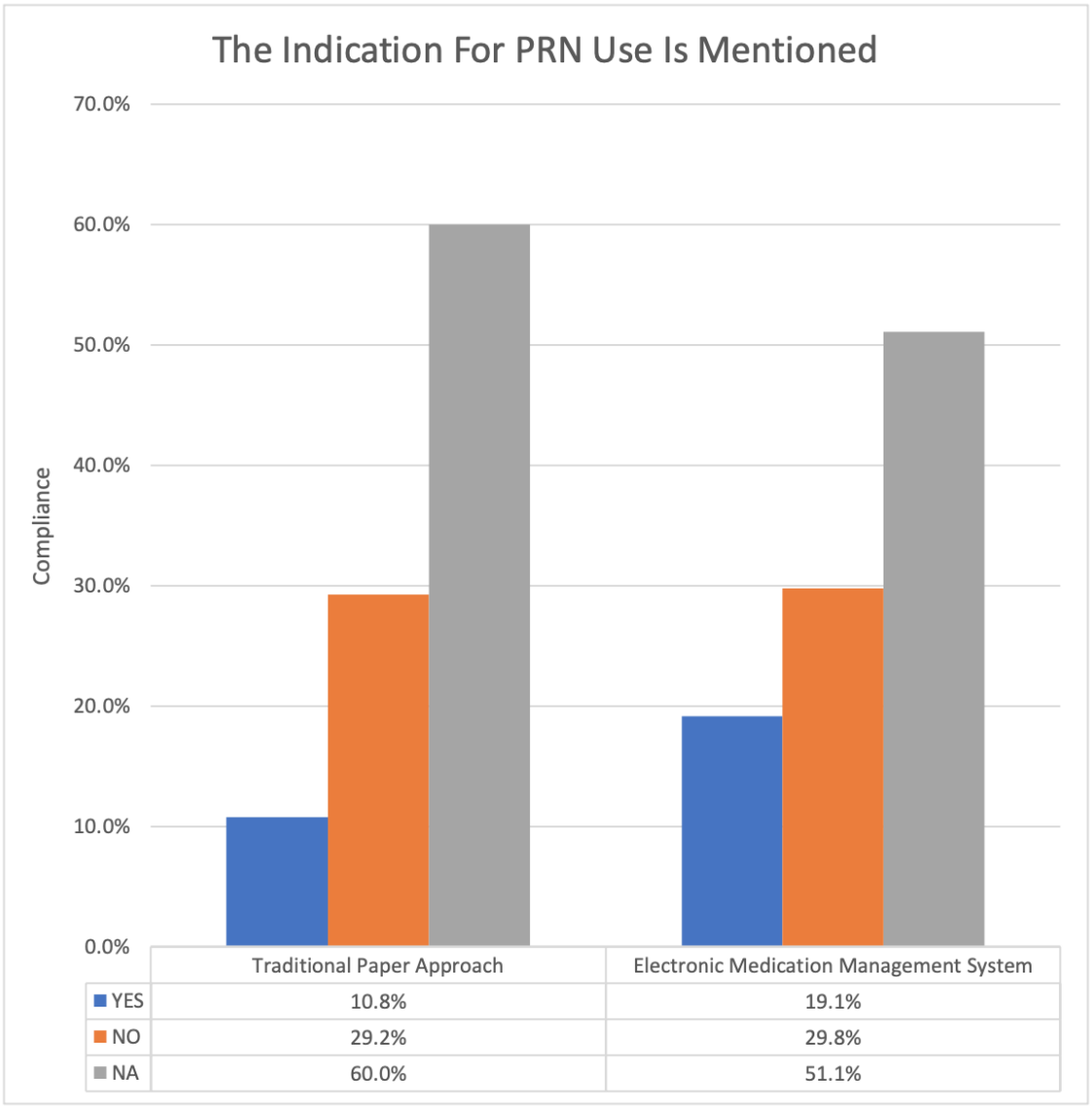


Figure 4.13: Total compliance with documented PRN indication between the paper and electronic documentation

4.4.14 Monitoring the first dose including documenting Adverse Reactions

According to Figure 4.14: "Monitoring the first dose including documenting adverse reactions" for both EMM System and traditional paper approach are nonapplicable in our study.

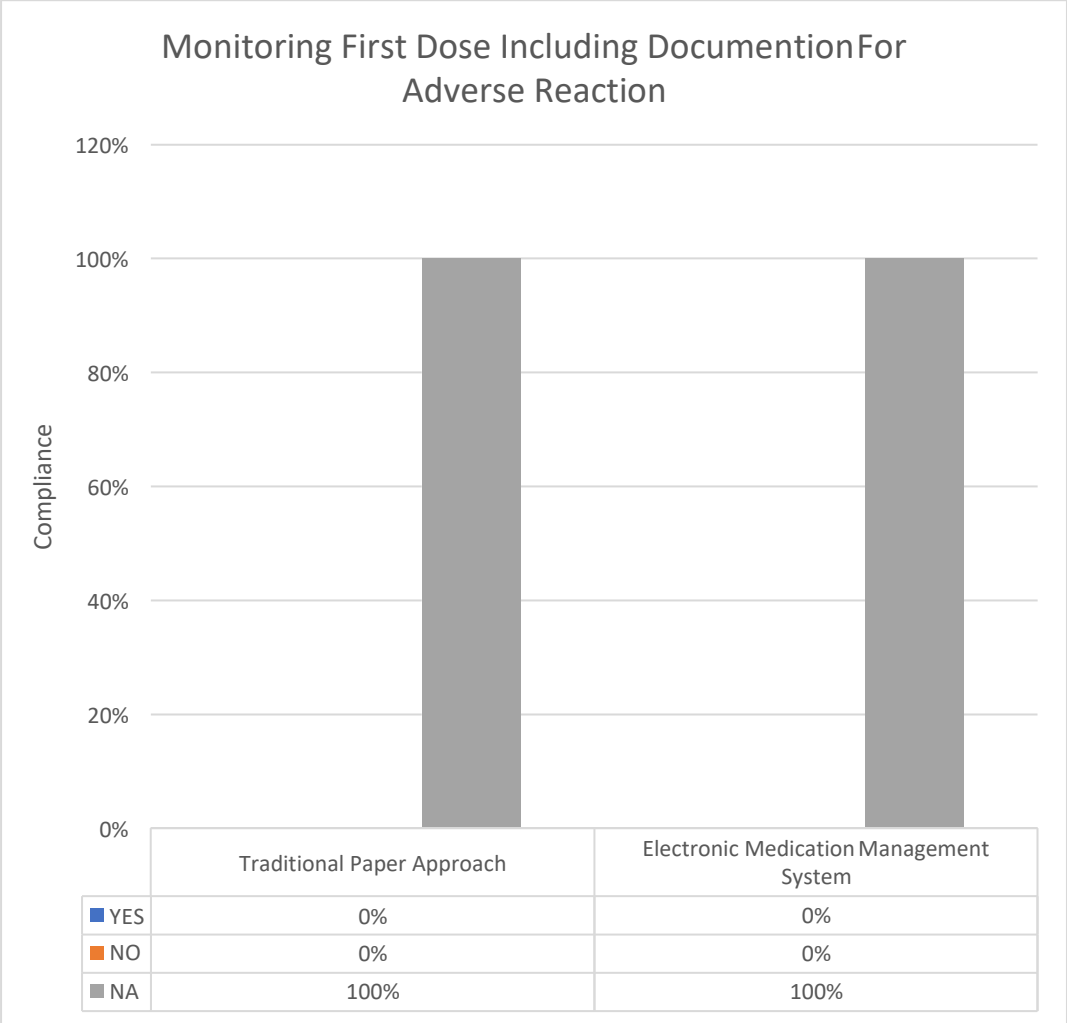


Figure 4.14: Total compliance with "Monitoring the first dose and documenting adverse reactions" between the paper and electronic documentation

4.5 Testing Hypothesis and Research Questions

4.5.1 Comparison between paper and electronic documentation

The results showed that the significance level P-value is less than the level of significance ($\alpha = 0.05$). Therefore, the researcher will reject the null hypothesis, and the alternative hypothesis will be accepted. The result indicated that the mean compliance with the Complete Medication Order documentation increased from 70.5 to 78 by using the EMM system, as shown in Table 4.3 below.

Table 4.3: Compliance with Complete Medication Order elements documentation according to the paper and electronic system. (T. Test)

Variables	"Complete Medication Order" Compliance			
	Mean	Std. Dev.	t value	P value
Traditional paper approaches	70.5	38.14	-5.40	0.000
Electronic approaches	78	37.81		

Table 4.3 concludes that there is a statistical significance impact of implementing EMM system on 'Complete Medication Orders' documentation.

4.5.2 (Patient Name, Patient ID and National ID)

The result indicated that the mean compliance with the Patient Name, ID, and National ID documentation increased from 95.8 to 100 by using the EMM system, as shown in Table 4.4 below.

Table 4.4: Compliance with Patient Name, Patient ID, and National ID documentation according to the paper and electronic system. (T. Test)

Variables	(Patient Name, Patient ID, and National ID) Order Element			
	Mean	Std. Dev.	t value	P value
Traditional paper approach	95.80	5.94	-1	0.50
EMM System	100	0		

Table 4.4 concludes that P-value is more than the level of significance (α = 0.05). Therefore, there is no statistically significance impact of implementing EMM system on 'Patient Name, IDS and National ID' documentation.

4.5.3 Clear legible Writing

The result indicated that the mean compliance with the (Clear Legible) documentation increased from 93 to 100 by using the EMM system, as shown in Table 4.5 below.

Table 4.5 : Compliance with clear legible writing according to the paper and electronic system. (T. Test)

Variables	Clear legible writing Compliance			
	Mean	Std. Dev.	t value	P value
Traditional paper approaches	93	19.18	-4.30	0.001
Electronic approaches	100	0		

Table 4.5 concludes that P-value is less than the level of significance (α = 0.05). Therefore, there is a statistical significance impact of implementing EMM system on 'Clear Legible' documentation.

4.5.4 Name of medicine (Generic and Trade)

The result indicated that the mean compliance with the Name of Medicine documentation increased from 95.8 to 96.15 by using the EMM system, as shown in Table 4.5 below.

Table 4.6: Compliance with Name of medicine; generic and Trade documentation according to the paper and electronic system. (T. Test)

Variables	Name of medicine; Generic and Trade Order Element			
	Mean	Std. Dev.	t value	P value
Traditional paper approach	95.80	5.94	-0.043	0.97
EMM System	96.15	5.44		

Table 4.6 concludes that P-value is more than the level of significance (α = 0.05). Therefore, there is no statistically significance impact of implementing EMM system on 'Patient Name, IDS and National IDS' documentation.

4.5.5 Time

The result indicates that the mean compliance with the Time documentation increased from 95.8 to 100 by using the EMM system, as shown in Table 4.6 below.

Table 4.7: Compliance with Time documentation according to the paper and electronic system. (T. Test)

Variables	Time Order Element			
	Mean	Std. Dev.	t value	P value
Traditional paper approach	95.80	5.94	-1	0.50
EMM System	100	0		

Table 4.7 concludes that P-value is more than the level of significance (α = 0.05). Therefore, there is no statistically significance impact of implementing EMM system on 'Time' documentation.

4.5.6 Dosage

The result indicates that the mean compliance with the Dosage documentation increased from 90.25 to 95 using the EMM system, as shown in Table 4.7 below.

Table 4.8: Compliance with Dosage documentation according to the paper and electronic system. (T. Test)

Variables	Dosage Order Element			
	Mean	Std. Dev.	t value	P-value
Traditional paper approaches	90.25	13.7	-0.38	0.76
EMM System	95	3.8		

Table 4.8 concludes that P-value is more than the level of significance ($\alpha = 0.05$). Therefore, there is no statistically significance impact of implementing EMM system on 'Dosage' documentation.

4.5.7 Route of Administration

The result indicated that the mean compliance with the Route of Administration documentation increased from 88.85 to 95 by using the EMM system, as shown in Table 4.8 below.

Table 4.9: Compliance with Route of Administration documentation according to the paper and electronic system. (T. Test)

Variables	Route of Administration Order Element			
	Mean	Std. Dev.	t value	P value
Traditional paper approaches	88.85	15.7	-0.44	0.73
EMM System	95	3.8		

Table 4.9 concludes that P-value is more than the level of significance ($\alpha = 0.05$). Therefore, there is no statistically significant impact of implementing the EMM system on 'Route of Administration' documentation.

4.6 Discussion

Due to the importance of proper documentation in the medical file, it reflects the care given to patients and reduces errors. Many suggest that electronic systems improve documentation (Chan et al., 2011). This research showed improved complete medication order documentation as the total compliance with the complete medication order elements improved from 70.5% in the paper forms to 78% in the electronic system. Our study's findings showed that the improvement of the documentation was statistically significant after the implementation of the EMM system. This finding supports Devine et al., (2010) study in which it concluded that the implementation of an EMM system showed a reduction in missing order information. The improvement of physicians' compliance with proper medication documentation predisposes to improved medication safety as well as improved patients' safety. Wittich et al., (2014) mentioned that a great deal of ME happening due to healthcare professional factors (e.g., improper documentation and the use of abbreviations) could be preventable. The research also mentioned that ME rates for medications administered intravenously are higher than those administered by other routes. Our research showed improved compliance with route documentation from 87.7% in the paper approach to 96.5% in the EMM system. This is of great importance as more attention would be given by pharmacists and other practitioners when dealing with medications administered intravenously. However, the results of our study showed that the improvement in route documentation was not statistically significant. This might be to the fact that the post-implementation study duration was insufficient.

In similar research, Abbass et al., (2011) revealed that MEs with the implementation of a EMM system decreased from 10.5% to 1.6%. However, the researcher mentioned another type of error associated with the EMM system, such as incorrect dosing. In our research, the dosage documentation improved from 89.2% to 96.5%, which does not support the findings of Abbas. The researcher also mentioned that allergies are among the errors that are associated with the EMM system. The data of our research suggest that allergy documentation has improved from only 3.1% to 15.6%. This might be because the EMM system is an integral part of the EMR, which gives the physician quick and easy access to patients' data other than the medication data, including allergies. Likewise, the improvement in frequency documentation in addition to the dosage documentation is vital. The Frequency documentation improved from 87.7% to 96.5%, while the Dosage documentation improved from 89.2 to 96.5%. However, the findings of our study concluded that the improvement is not statistically significant. Therefore, a longer study period is needed to further confirm our findings. An improvement in dosage and frequency documentation will ensure a definitive reduction of potential MEs, because prescription errors account for the vast majority of MEs (Velo & Minuz, 2009). Dosage selection accounted for more than half of all prescription errors (Velo & Minuz, 2009). Similar studies showed that the implementation of the EMM system improved the prescription process and reduced prescription errors (Westbrook et al., 2013; Winata et al., 2021)

During this research's pre EMM system implementation phase, the medication order was first written on the Doctor Request sheet, as shown in Appendix C. Secondly, the drug request was transcribed into the Kardex for administration purposes. This process

adds to the possibility of errors during the medication process. However, due to the introduction of the new system, the electronization reshaped the medication order process. This research lacks data on how the elimination of the transcription process improved or reduced MEs. It was mentioned in another research that the transcription of the medication order from one paper to the other is a significant source of error (Callen et al., 2010).

Similarly, the dispensing process in IAH was reshaped during the EMM system phase. Pharmacists were receiving handwritten orders which are prone to misinterpretations and incorrect dispensing, and thus medication incidents. The results of this research showed that the EMM system had a statistically significant impact on clear legible writing. Medication incidents are beyond the scope of this research, but further research is needed to complement our research findings. In our study, we looked at the impact of the EMM system on medication documentation. Further studies should be conducted to investigate the medication incidents due to improper documentation during both phases; the paper and EMM system phase. Besides medication incidents, several research mentioned that the implementation of EMM system gives rise to new types of errors not generated by the paper documentation (Winata et al., 2021). Future studies must inquire into new types of errors.

Medication Errors are a matter of contention in the JCI program due to the direct and high impact on patients' safety. Hospitals use the Monitoring Tool for auditing their physicians' performance and compliance with the JCI standards. However, there is only one literature about the

Impact of JCI accreditation in decreasing or eliminating MEs. The study showed that the occurrence rate of MEs decreased by 60% (Wang et al., 2015). Our study will contribute to the literature available and provide evidence about the impact of implementing an EMM system as a tool to improve compliance with complete medication order elements.

The generalizability of our results is impacted by the fact that the post-implementation data did not consider the learning period of the staff and their adaptation to the new system. Therefore, further studies should be conducted on future dates.

4.7 Summary of Chapter Four

This chapter presents a detailed discussion of the results obtained from this study. In addition, a clear comparison of results between the paper vs. electronic approaches was analyzed.

CHAPTER FIVE:

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the impact of implementing an EMM System on medication safety through studying the compliance with ‘complete medication orders’ documentation. This chapter also proposes future work, and recommendations are nominated further to evaluate the EMM system's impact on medication safety.

5.2 Conclusions

This research studied the impact of implementing a EMM system on medication safety. This was done based on the analysis of data collected using a JCI tool, which was developed for assessing compliance with ‘complete medication orders’ documentation.

The researchers found a statistically significant impact of the EMM system on medication safety, which was shown by the increased compliance with the ‘complete medication order’ documentation.

The following are the essential results concluded in the study according to the importance of their impact on the healthcare provided in the hospitals:

- The compliance with compliant documentation of (Patient Name, Patient ID and National ID) increased with using EMM System.
- The compliance with the Name of medicine (Generic and Trade) documentation increased using EMM System.
- Total compliance with date documentation increased with using the EMM System.

- Total compliance with the time documentation increased with using the EMM System.
- The compliance with the dosage documentation increased by using EMM System.
- The compliance with the Route of administration documentation increased by using EMM System.
- The compliance with the frequency documentation increased by using EMM System.
- The compliance with Doctor's stamp & signature increased by using EMM System.
- The compliance with the allergy documentation increased by using EMM System.
- The compliance with clear legible writing increased by using EMM System.
- The compliance with writing the medication in capital letters increased by using EMM System.
- The compliance with the indication for PRN documentation increased by using EMM System.
- **"**Monitoring the first dose including documenting adverse reactions" for both EMM System and the traditional paper approach is nonapplicable in our study.

5.3 Recommendations

The researcher recommends the following:

- As this is a new system, further training should be conducted to raise awareness about the new system, until complete compliance is achieved.
- To provide the hospital with the ultimate use of the new system, some additional features might be required. The prescription process should be supported by Clinical Decision Support System, in which appropriate notifications are generated to aid the

prescribers in filling the prescription. In addition to that, better integration with other diagnostic information derived from the patients, file, recommendations can be set up to assist physicians in choosing the appropriate medication plan.

- This retrospective study has examined whether the new system has improved the physicians' compliance towards a complete medication order. However, it has not examined the causality of the noncompliance, which might contribute to our understanding of the results of the study.

5.4 Future Work

- The newly implemented EMM System provided benefits to the hospital's medication process; however, complete compliance was not achieved. Therefore, more studies should be introduced to assess the cause behind the noncomplete compliance.

- New studies should be carried out in which the medication-related incident reports are taken into account. This is to be done to reflect on the results and harm behind noncompliance.

REFERENCES

JCI | Joint Commission International. (n.d.). Retrieved August 27, 2021, from https://www.jointcommissioninternational.org/about-jci/

Abbass, I., Mhatre, S., Sansgiry, S., Tipton, J. & Frost, C. (2011). Impact and determinants of commercial computerized prescriber order entry on the medication administration process. *Hospital Pharmacy*, *46*(5), 341–348. https://doi.org/10.1310/hpj4605-341

Aldosari, B. (2017). Patients' safety in the era of EMR/EHR automation. *Informatics in Medicine Unlocked*, *9*(October), 230–233. https://doi.org/10.1016/j.imu.2017.10.001

Alkureishi, M. A., Lee, W. W., Lyons, M., Press, V. G., Imam, S., Nkansah-Amankra, A., Werner, D. & Arora, V. M. (2016). Impact of Electronic Medical Record Use on the Patient–Doctor Relationship and Communication: A Systematic Review. *Journal of General Internal Medicine*, *31*(5), 548–560. https://doi.org/10.1007/s11606-015-3582-1

Attaallah, A. F., Elzamzamy, O. M., Phelps, A. L., Ranganthan, P. & Vallejo, M. C. (2016). Increasing operating room efficiency through electronic medical record analysis. *Journal of Perioperative Practice*, *26*(5), 106–113. https://doi.org/10.1177/175045891602600503

Callen, J., McIntosh, J. & Li, J. (2010). Accuracy of medication documentation in hospital discharge summaries: A retrospective analysis of medication transcription errors in manual and electronic discharge summaries. *International Journal of Medical Informatics*, *79*(1), 58–64. https://doi.org/10.1016/j.ijmedinf.2009.09.002

Chan, T. C., Griswold, W. G., Buono, C., Kirsh, D., Lyon, J., Killeen, J. P., Castillo, E. M. & Lenert, L. (2011). Impact of wireless electronic medical record system on the quality of

Patient documentation by emergency field responders during a disaster mass-casualty exercise. *Prehospital and Disaster Medicine*, *26*(4), 268–275. https://doi.org/10.1017/S1049023X11006480

Devine, E. B., Hansen, R. N., Wilson-Norton, J. L., Lawless, N. M., Fisk, A. W., Blough, D. K., Martin, D. P. & Sullivan, S. D. (2010). The impact of computerized provider order entry on medication errors in multispecialty group practice. *Journal of the American Medical Informatics Association*, *17*(1), 78–84. https://doi.org/10.1197/jamia.M3285

Dipiro, J. T., Talbert, R. L., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (2017). Pharmacotherapy A Pathophysiologic Approach. In *Management of Laparoscopic Surgical Complications*. https://doi.org/10.5694/j.1326-5377.1989.tb136626.x

Fritz, F., Tilahun, B. & Dugas, M. (2015). Success criteria for electronic medical record implementation in low-resource settings: A systematic review. *Journal of the American Medical Informatics Association*, *22*(2), 479–488. https://doi.org/10.1093/jamia/ocu038

Furukawa, M. F. (2011). Electronic Medical Records and the Efficiency of Hospital Emergency Departments. *Medical Care Research and Review*, *68*(1), 75–95. https://doi.org/10.1177/1077558710372108

Gozlu K & Kaya S. (2016). Patient safety culture as perceived by nurses in a Joint Commission International Accredited hospital in Turkey and its comparison with Agency for Healthcare Research and quality data : *PSQI Journal*, *4*(4), 441–449.

Harrington, L., Kennerly, D. & Johnson, C. (2011). Safety issues related to the electronic medical record (EMR): synthesis of the literature from the last decade, 2000-2009. *Journal of Healthcare Management / American College of Healthcare Executives*, *56*(1), 31–34.

Hartel, M. J., Staub, L. P., Röder, C. & Eggli, S. (2011). High incidence of medication documentation errors in a Swiss university hospital due to the handwritten prescription process. *BMC Health Services Research*, *11*. https://doi.org/10.1186/1472-6963-11-199

Hughes, R. G. (2008). Patient Safety and Quality. *Patient Safety and Quality: An Evidence- Based Handbook for Nurses*, *28*, 1–285. https://www.ncbi.nlm.nih.gov/books/NBK2651/

Hughes, R. G. & Blegen, M. A. (2007). *Chapter 37 . Medication Administration Safety*.

Lau, F., Price, M., Boyd, J., Partridge, C., Bell, H. & Raworth, R. (2012). Impact of electronic medical records on physician practice in office settings: A systematic review. *BMC Medical Informatics and Decision Making*, *12*(1). https://doi.org/10.1186/1472-6947-12-10

Lazaryan, M., Berkovitch, S., Toledano, M., Yehoshua, N. R.-, Abu-Kishk, I. & Berkovitch, M. (2016). JOINT COMMISSION INTERNATIONAL (JCI) IN THE PEDIATRIC INTENSIVE CARE UNIT (PICU): PREVENTING MEDICATION INCIDENTS THROUGH REMOTE CONTROL. *Archives of Disease in Childhood*, *101*(1), e1 LP-e1. https://doi.org/10.1136/archdischild-2015-310148.31

Lichtner, V., Baysari, M., Gates, P., Dalla-Pozza, L. & Westbrook, J. I. (2019). Medication safety incidents in paediatric oncology after electronic medication management system implementation. *European Journal of Cancer Care*, *28*(6), 1–9. https://doi.org/10.1111/ecc.13152

Liu, J., Luo, L., Zhang, R. & Huang, T. (2013). Patient satisfaction with electronic medical/health records: A systematic review. *Scandinavian Journal of Caring Sciences*, *27*(4), 785–791. https://doi.org/10.1111/scs.12015

Michael F. Furukawa, P. (2011). Electronic Medical Records and Efficiency and Productivity During Office Visits. *American Journal of Managed Care*, *17*(April 2011 4), 296–303.

Ofi, B. & Sowunmi, O. (2012). Nursing documentation: Experience of the use of the nursing process model in selected hospitals in Ibadan, Oyo State, Nigeria. *International Journal of Nursing Practice*, *18*(4), 354–362. https://doi.org/10.1111/j.1440-172X.2012.02044.x

Okaisu, E. M., Kalikwani, F., Wanyana, G. & Coetzee, M. (2014). Improving the quality of nursing documentation: An action research project. *Curationis*, *37*(1). https://doi.org/10.4102/curationis.v37i1.1251

Paans, W., Sermeus, W., Nieweg, R. M. B. & Van Der Schans, C. P. (2010). Prevalence of accurate nursing documentation in patient records. *Journal of Advanced Nursing*, *66*(11), 2481–2489. https://doi.org/10.1111/j.1365-2648.2010.05433.x

Redley, B. & Botti, M. (2013). Reported medication errors after introducing an electronic medication management system. *Journal of Clinical Nursing*, *22*(3–4), 579–589. https://doi.org/10.1111/j.1365-2702.2012.04326.x

Saine, D. & Larson, C. M. (2006). *Medication Safety Officer : Getting Started*. 1–38.

Scruth, E. A. (2014). Legal and ethical : Quality nursing documentation in the medical record. *Clinical Nurse Specialist*, *28*(6), 312–314. https://doi.org/10.1097/NUR.0000000000000085

Velo, G. P. & Minuz, P. (2009). Medication errors: Prescribing faults and prescription errors. *British Journal of Clinical Pharmacology*, *67*(6), 624–628. https://doi.org/10.1111/j.1365-2125.2009.03425.x

Wang, H. F., Jin, J. F., Feng, X. Q., Huang, X., Zhu, L. L., Zhao, X. Y. & Zhou, Q. (2015). Quality improvements in decreasing medication administration errors made by nursing staff in an academic medical center hospital: A trend analysis during the journey to Joint Commission International accreditation and in the post-accreditation era. *Therapeutics and Clinical Risk Management*, *11*, 393–406. https://doi.org/10.2147/TCRM.S79238

Weant, K. A., Bailey, A. & Baker, S. (2014). Strategies for reducing medication errors in the emergency department. *Open Access Emergency Medicine*, 45. https://doi.org/10.2147/oaem.s64174

Westbrook, J. I., Gospodarevskaya, E., Li, L., Richardson, K. L., Roffe, D., Heywood, M., Day, R. O. & Graves, N. (2015). Cost-effectiveness analysis of a hospital electronic medication management system. *Journal of the American Medical Informatics Association*, *22*(4), 784– 793. https://doi.org/10.1093/jamia/ocu014

Westbrook, J. I., Li, L., Georgiou, A., Paoloni, R. & Cullen, J. (2013). Impact of an electronic medication management system on hospital doctors' and nurses' work: A controlled pre- post time and motion study. *Journal of the American Medical Informatics Association*, *20*(6), 1150–1158. https://doi.org/10.1136/amiajnl-2012-001414

Winata, S., Liacos, M., Crabtree, A., Page, A. & Moran, C. (2021). Electronic Medication Management System Introduction and Deprescribing Practice in Post-Acute Care. *Journal of the American Medical Directors Association*, *22*(1), 90–95. https://doi.org/10.1016/j.jamda.2020.10.015

Wittich, C. M., Burkle, C. M. & Lanier, W. L. (2014). Medication errors: An overview for clinicians. *Mayo Clinic Proceedings*, *89*(8), 1116–1125. https://doi.org/10.1016/j.mayocp.2014.05.007

World Health Organization; 2017. (2017). Patient safety. In *Anales de Medicina Interna* (Vol.24, Issue 12). https://doi.org/10.4321/S0212-71992007001200010

APPENDIX A

المستشفى الإستشاري العربي

ISTISHARI ARAB HOSPITAL

الاسم : ______________________ رقم الملف : __________

العمر : __________ الجنس : __________ القسم : __________

رقم الغرفة / رقم السرير : ______________________

Pervious Relevant Therapy

DRUG IDIOSYNCRACY

Aperients / simple analgesics may / may not be given

BODY WEIGHT Kilograms

Date	ONCE ONLY & PREMEDICATION DRUGS	Dose	Route	Time	Prescriber's Signature	Given by nurse/ Signature

APPENDIX A: Kardex

PATIENT'S NAME

AS REQUIRED Prescriptions					Date	Time	Given by	Date	Time	Given by	Date	Time	Given by	Date	Time	Given by
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												
Drug																
	Prescriber															
Dose	Route	Minimum Interval	Start Date	Stop Date												

REGULAR PRESCRIPTIONS

MONTH and DATE →
Fill TIMES Required
Drug (Approved Name)
Route | Dose | Start Date | Stop Date
Drug (Approved Name)
Route | Dose | Start Date | Stop Date
Drug (Approved Name)
Route | Dose | Start Date | Stop Date
Drug (Approved Name)
Route | Dose | Start Date | Stop Date
Drug (Approved Name)
Route | Dose | Start Date | Stop Date
Signature

APPENDIX B

Doctor Request Sheet

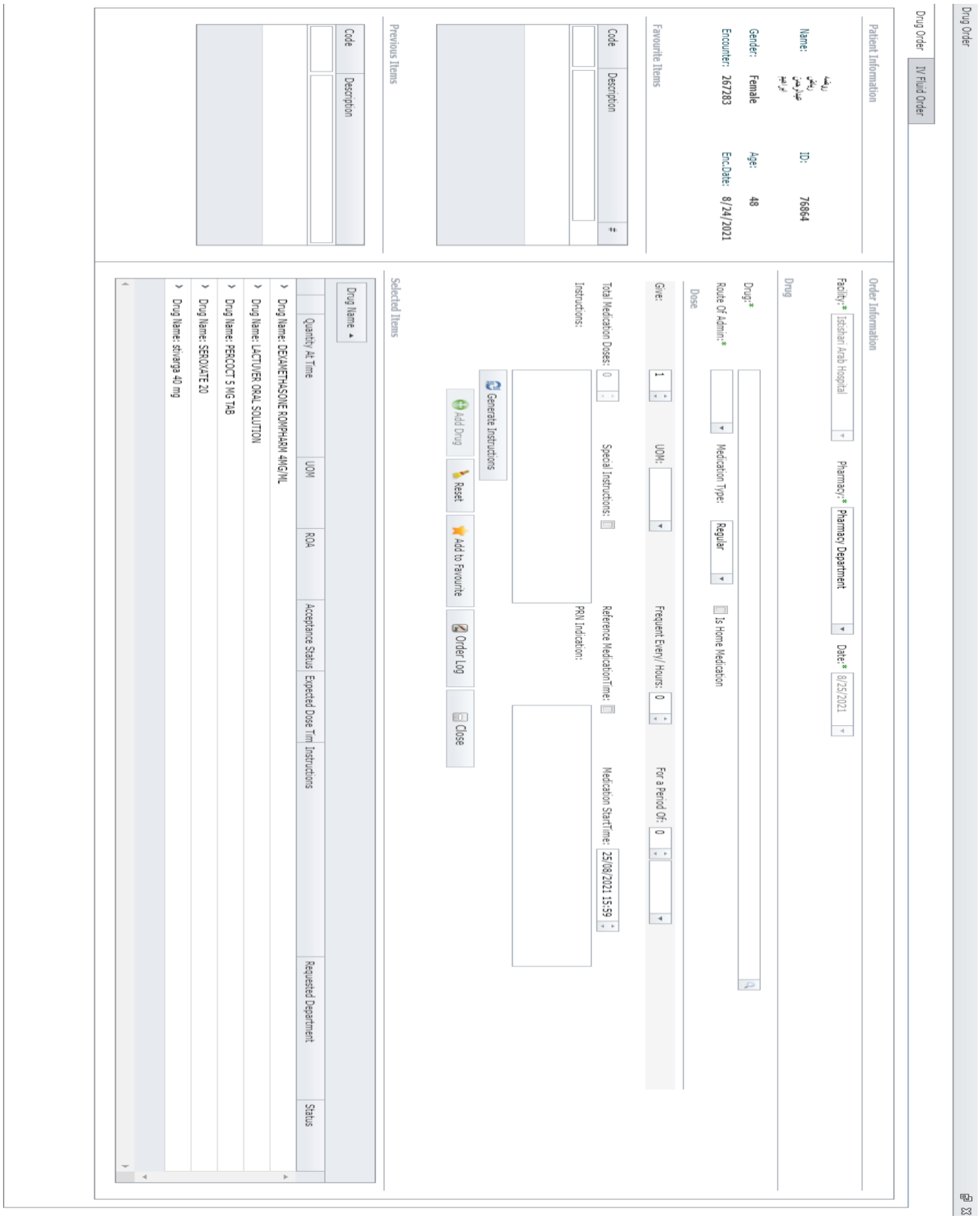
Pt. Label

Diagnosis: .....

Date	Time	Doctor Request	Doctor Name & Sign.	Nurse Sign.

APPENDIX B: Doctor Request Sheet

APPENDIX C



APPENDIX C: Drug Order Screen

APPENDIX D

Monitoring Tool (Complete Medication Order)

Date:

Element	Yes	No	NA	Remarks
Case #1/Ward :				
Complete medication order element includes:				
• Patient Name, Patient ID and National ID.				
• Name of medicine (Generic and Trade).				
• Date.				
• Time.				
• Dosage.				
• Route of administration.				
• Frequency.				
• Doctor's stamp & signature				
• Allergy				
• Clear legible writing in blue or black ink.				
The medication is written in capital letters.				
The indication for PRN use is mentioned.				
Monitoring first dose including documented for Adverse reaction.				
Element	**Yes**	**No**	**NA**	**Remarks**
Case #2/Ward :				
Complete medication order element includes:				
• Patient Name, Patient ID and National ID.				
• Name of medicine (Generic and Trade).				
• Date.				
• Time.				
• Dosage.				
• Route of administration.				
• Frequency.				
• Doctor's stamp & signature				
• Allergy				
• Clear legible writing in blue or black ink.				
The medication is written in capital letters.				
The indication for PRN use is mentioned.				
Monitoring first dose including documented for Adverse reaction.				

APPENDIX D: Study Tool

APPENDIX E

IAH Research Application Form

Date	
Name of investigator	Kayan AbuKhaizaran
Mobile No.	
Email	Kayan@iah.ps
Expected start date	
Expected completion date	
Name of Company/University	Arab American University - Palestine
Attached needed	
Investigator CV	☑Yes ☐No
Study Proposal	☑Yes ☐No
Consent Form	☐Yes ☐No
Data Collection Tools	☑Yes ☐No
Informed Consent (Arabic & English)	☐Yes ☐No
For Ethical Committee	
Receiving Date	
Ethical Committee Approval	☑Yes ☐No
Ethical Committee Note	Nothing to Declare Approved.
Head of Ethical committee Sig.	د. محمد زيدان رئيس الفدد الصماء والسكري
CEO Note	It is approved
CEO Sig.	

- For Non Experimental Research only

APPENDIX E: IAH Ethical Committee Approval

الملخص

الهدف:

بالنظر الى مدى أهمية توفير رعاية المرضى بطريقة موثوقة، متناسقة وآمنة، لكل من المرضى وذويهم. يجب على المستشفيات أن تلتزم بتزويد مرضاهم بالتجربة الرعائية الأكثر أماناً. لقد ساعدت السجلات الطبية الالكترونية العاملين في مجال الرعاية الصحية على تحسين سلامة الرعاية المقدمة الى المرضى، لكن حتى الآن، هناك القليل من الأدلة الإحصائية حول فعالية أنظمة إدارة الأدوية الإلكترونية في تحسين السلامة الدوائية. تهدف هذه الدراسة الى دراسة تأثير تطبيق نظام إدارة الأدوية الإلكترونية على السلامة الدوائية في المستشفى الاستشاري العربي.

المنهجية:

دراسة غير تجريبية .استخدمت الدراسة نهج التحليل الكمي (دراسة بأثر رجعي) لتحديد تأثير تطبيق نظام إدارة الأدوية الإلكترونية على السلامة الدوائية .تم جمع البيانات من الملفات الطبية الورقية وسجل إدارة الدواء الورقي (الكارديكس) على مدى شهرين، ومن ثم تم جمعها من نفس الأقسام باستخدام السجل الطبي الإلكتروني على مدى ثلاثة أشهر .تمت مقارنة النتائج لمعرفة تأثير تطبيق نظام إدارة الأدوية الإلكتروني مقابل الملف الطبي الورقي.

النتائج الرئيسية:

أظهرت الدراسة انه التزام الأطباء بالتوثيق الكامل للطلب إعطاء الدواء قد ارتفع من 70.5٪ في حالة التوثيق الورقي، الى نسبة 78٪ من خلال التوثيق الإلكتروني. وأظهرت النتائج انه كان هناك تأثير إيجابي ذات دلالة إحصائية على التوثيق الدوائي بعد استخدام النظام الالكتروني.

الخلاصة:

اظهر الدراسة ان هناك حاجة لإستخدام النظام الإلكتروني مما له أثر إيجابي على التوثيق الشامل لطلبات الادوية. مما يؤدي لتحسين السلامة الدوائية.