The Role of Electronic Health Records in Structuring Nursing Handoff Communication and Maintaining Situation Awareness

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By

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

THE ROLE OF ELECTRONIC HEALTH RECORDS IN STRUCTURING HANDOFF COMMUNICATION AND MAINTAINING SITUATION AWARENESS AMONG NURSES DURING HANDOFF

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DEDICATION

This dissertation is dedicated to my parents for their love, prayers, encouragement, and continuous support, specifically, my mother Shiekha who instilled in me the inspiration to set high goals, and my father Amer who instilled the confidence to achieve these goals.

I also dedicate this work to my loving wife Shiekha, and to my children, Abdulraheem, Azzeldeen, Retal, and Allaeldeen. Without their patience, endurance, and steadfast support this work would not exist.

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ABSTRACT

In healthcare institutions, work must continue 24 hours a day, 7 days a week. A team of nurses is needed to provide around-the-clock patient care, and this process requires transfer of patient care responsibilities, a process known as a "handoff." The present study explored the role of electronic health records in structuring handoff communication and maintaining situation awareness among nurses during handoff. Several theoretical frameworks and models were used to guide this study, which aims to assess the satisfaction of nurses regarding the usefulness and ease of use of the electronic health records for nurses during handoff, to explore the contents and the context of nursing handoff, and to explore the artifacts that the nurses use to in order to ensure the continuity of care and the delivery of quality handoff reports. A mixed-method, quantitative and qualitative, approach was used to study the role of the electronic health records in structuring handoff communication and to explore handoff practices in Oman. The findings of this study demonstrated that the nurses had positive perceptions about the usefulness and ease of use of electronic health records for structuring handoff communication and promoting effective and efficient transition of patient care during handoff. The study also revealed that nurses use a variety of artifacts to document, communicate, and coordinate patients' care reasonability during handoff. The electronic health records, Al-Shifa, were found to be the primary artifact that the nurses used to facilitate electronic documentation of patient care and to promote effective and accurate communication among the nurses during the transition of care. The use of electronic health records during handoff was reported to increase the accessibility to patients' medical records and ensure both the continuity of care and the delivery of quality handoff

reports. Despite the integration of electronic health records into the handoff reports, all the observed nurses (N =97) and the surveyed nurses (N =157) used a piece of paper to summarize the key information they received during the handoff report. Throughout the shift, this piece of paper served as a non-digital artifact that provided “quick-reference” for the nurses as well as a “to-do list”.

CHAPTER 1: INTRODUCTION

1.1 Introduction

In critical systems such as healthcare institutions, work must continue 24 hours a day, all year round (Wilson, Randell, Galliers, & Woodward, 2009). A team of nurses is needed to offer around-the-clock patient care and this process requires transfer of patient care responsibilities. This transfer, known as a "handoff", takes place among a team of nurses at least two or three times a day. The Australian Commission on Safety and Quality in Health Care defines handoff as "The transfer of professional responsibility and accountability for some or all aspects of care for a patient, or group of patients, to another person or professional group on a temporary or permanent basis" (2010, p. 4). During handoff, it is important to ensure information is exchanged between health care professionals along with the transfer of patient care responsibility (Wilson, et al., 2009). For this to occur, handoffs require highly complex communication between staff members that involve both people and information technologies (Groah, 2006; Wilson, et al., 2009). Effective handoffs between professionals was reported to be the heart of an effective health care system (Pothier, Monteiro, Mooktiar, & Shaw, 2005).

The primary goal of a handoff is to provide the incoming nurse with accurate, relevant, and up-to-date clinical information about the patient such as current condition, anticipated changes, treatments, pending procedures, and other services (Aboshaiqah, 2010; Nelson & Massey, 2010; Strople & Ottani, 2006; Wilson, et al., 2009). Despite the importance of the handoff, it has been reported to be an ongoing problem around the world (Australian Commission on Safety and Quality in Health Care, 2006; Bomba & Prakash, 2005; Joint Commission Center for Transforming Healthcare, 2010). Studies

regarding handoffs in healthcare facilities in developed Western countries have shown that communication gaps during handoff greatly increase the risk to patient safety (Australian Commission on Safety and Quality in Health Care, 2006; Joint Commission Center for Transforming Healthcare, 2010; Strople & Ottani, 2006; World Health Organization, 2007). In 2010, the Joint Commission Center for Transforming Healthcare (JCCTH) studied the root cause of handoff communication failure among ten U.S. hospitals. They found that a number of interacting factors between the sender of information (outgoing nurse) and the receiver of information (incoming nurse) precipitate communication failure. For instance, failure of the sender to provide accurate or complete information was reported to be the root cause of handoff communication failure among all ten hospitals In addition, the JCCTH found the lack of standardized handoff communication methods and tools to be a common cause of handoff communication failure among six of the hospitals.

Despite the fact that handoffs are reported to be a worldwide problem in nursing, there is a dearth of knowledge about these events in many countries. For instance, it has not been studied in healthcare institutions in developing countries, such as the Sultanate of Oman (Oman). The healthcare system in Oman uses Al-Shifa, a homegrown electronic health records system (see Appendix Q). Al-Shifa was developed by Oman's Ministry of Health as a means to improve the efficiency and reliability of documentation and communication among multidisciplinary teams of healthcare professionals. However, it is not clear how the use of electronic health records support the transition of care and exchange of patient information across working shifts, especially when there is no explicit policy that standardizes what information needs to be included in handoff reports.

The present study is guided by several theoretical frameworks and models to explore the contents of nursing handoff and understand the use of electronic health records to support information exchange among nurses during handoff. To gain a holistic understanding of the activities surrounding nursing handoff, the current study is guided by the theory of distributed cognition, the Technology Acceptance Model (TAM), and the Situation, Background, Assessment and Recommendation (SBAR) handoff communication format.

Theory of distributed cognition was adapted to explain the sociotechnical interaction among the nurses and the artifacts that the nurses used in the context of nursing handoff. The Technology Acceptance Model (TAM) was adapted to assess the nurses' satisfaction about the usefulness and ease of use of the electronic health record, particularly in the context of nursing handoff. The Situation, Background, Assessment and Recommendation (SBAR) handoff communication format was used to guide the researcher to identify, categorize and cluster the information communicated during nursing handoff.

1.2 Problem associated with ineffective handoff practices

Poor handoffs have been repeatedly recognized to be potentially dangerous for patient safety and lead to adverse events (Mistry, Toulany, Edmonds, & Matlow, 2010). For instance, in the United States, it is estimated that 80 % of serious medical errors have been attributed to breakdown in communication during handoff (Joint Commission Center for Transforming Healthcare, 2010). Problems surrounding handoffs have been attributed to the lack of a structured handoff communication format, leading nurses to rely heavily on their memories when giving handoff reports. The reliance on memory

greatly contributes to incomplete information or loss of information across the transitions of care (Groff & Augello, 2003; Matic, Davidson, & Salamonson, 2010; Olson, 2008). Consequently, relying on human memory during the verbal handoff has been reported to be one of the leading causes of adverse events (Leonard, Graham, & Bonacum, 2004).

Handoff is not merely a way of sharing information. It involves preparation and presentation of the report, as well as clarification of the information exchanged, processes which have been reported to be time consuming, especially for the outgoing nurses (Staggers & Jennings, 2009). Wilson, et al.(2009) found healthcare staff spent a vast amount of their time during handoff to maintain their own and others' situation awareness, most of which are maintained verbally through asking questions, answering questions and telling each other things to do. Staggers & Jennings (2009) attributed lengthy reports to the fact that there are no structured tools for nurses to use during handoff and the electronic health records are not customized to fit the nurses informational needs during handoff.

Little is known about the effectiveness and the efficiency of electronic health records in supporting nursing handoff (Staggers & Jennings, 2009). Thus, the current study aims to assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff. In addition, the present study aims to explore the handoff practices in Oman and identifies the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure the continuity of care and the delivery of quality handoff report.

1.3 Problem Statement

Poor handoffs have been repeatedly recognized to be a worldwide issue in clinical care settings that threaten patient safety. Problems surrounding handoffs have been attributed to a lack of a structured handoff communication format, and disintegration of electronic health records during handoff report. The current health policy in developing countries such as Oman mandates the implementation of paperless documentation systems, where all aspects of patient care are documented and communicated using the electronic health records. The reason for the implementation of electronic health records is to ensure the completeness and the integrity of documentation that would ultimately promote the continuity of care, quality of care, and patient safety. Despite introducing the electronic system and the extensive training that nurses received, nurses continue to use verbal reports during handoffs and rely on non-digital cognitive artifacts, such as scraps of paper, to maintain team distributed cognition. However, it is not known how nurses in Oman healthcare facilities utilize the electronic health records in facilitating consistent information exchange during handoff. In addition, there is no policy in Oman that standardizes handoff procedures and what information needs to be communicated during handoff. Consequently, the lack of handoff standardization and lack of integration of electronic health records during handoff report can cause information gaps during handoff.

1.4 Specific Aims, Research Questions, and Hypotheses

Mixed method approaches are employed to explore the role of electronic health records during handoff and capture the activities surrounding handoff practices in Oman.

1.4.1 Research Goals

The present study addresses the following four aims:

1) Assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff.

2) Explore the content and the context of handoff practice in Oman.

3) Identify the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure continuity of care and the delivery of quality handoff reports.

4) Identify the strengths and the weaknesses of the electronic health records in supporting quality handoff report.

1.4.2 Research Questions

The study addresses the following research questions (RQs):

RQ1. How satisfied are nurses with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff?

RQ2. What is the content and the context of nursing handoff in Oman?

RQ3. What digital and non-digital artifacts do nurses use to convey information between shifts and maintain distributed cognition among the health team members during handoff, and how are these artifacts integrated into the handoff reports?

RQ4. What are the strengths and the shortcomings of the electronic health records in supporting quality handoff reports during nursing handoff?

1.4.3 Hypotheses

The study addresses the following hypotheses:

1) There is a relationship between perceived usefulness of electronic health records and the likelihood of using them during handoff.
2) There is a relationship between perceived ease of use of electronic health records and the likelihood of using them during handoff.
3) There is a relationship between perceived usefulness of electronic health records and the perceived quality handoff report.
4) There is a relationship between perceived ease of use of electronic health records and the perceived quality handoff report.

1.5 Research design

The present study is an exploratory study that uses a mixed-method, quantitative and qualitative approach that was conducted in two phases. Multiple data sources and analysis techniques have been used to capture the activities surrounding nursing handoff. During the first phase of the study, a survey questionnaire was used to obtain preliminary information about the practice of nursing handoff in Oman and to assess the nurses' perception about the usefulness and ease of use of electronic health records during handoff. During the second phase of the study, semi-structured interviews, artifact analysis, and participant observation were used to obtain in-depth information pertaining to the handoff practice in Oman and to explore the role of electronic health records in maintaining situation awareness among nurses in the distributed cognition of handoff.

1.6 Significance of the Study

Given the fact that handoffs have been reported to be a worldwide issue in clinical care settings, it is important to study this issue, particularly in a developing country like Oman where emergent electronic health records are becoming the primary vehicle for information communication and exchange among multidisciplinary teams of healthcare professionals. Findings of this study will contribute to the body of knowledge by satisfying the literature gap on the understanding of the role of electronic health records in structuring and standardizing handoff communication. The present study takes a novel approach versus previous studies by: exploring the role electronic health records in enhancing the situational awareness between the sender and the receiver of information during nursing handoff, applying the technology acceptance model to assess the nurses' satisfaction about the usefulness and ease of use of the electronic health records for nurses during handoff, and exploring the role of electronic health records in structuring and standardizing handoff communication.

1.7 Definition of Terms

- **Adverse events**: any undesirable effects that the patient may experience during their course of treatment.
- **Acute care setting**: a short-term medical treatment, usually in a hospital, for patients recovering from surgery or having an acute illness or injury (American Heritage Dictionary of the English Language, 2000). In this study, it refers to medical-surgical, nephrology, and oncology inpatient units.
- **Artifacts**: any tools or objects that help in organizing and coordinating work and maintaining situation awareness among the team members. Artifacts can be digital or non-digital.
- **Continuity of care**: the process by which nurses cooperatively and collaboratively work with the patient to ensure consistency in the delivery of health care.
- **Context of nursing handoff**: refers to the aspects of nursing handoff that include the setting, the process and the practice of nursing handoff, and activities surrounding nursing handoff.
- **Digital artifacts:** any computerized tools or devices that are used to organize and coordinate work and maintain situation awareness among the team members, such as electronic health records.
- **Distributed cognition**: theoretical framework that studies the distributed cognitive process beyond the individual level to include groups and material artifacts (Hutchins & Lintern, 1995).
- **Electronic charting**: the ability to document all aspects of patient care into an electronic health record.

- **Handoff**: the process of passing patient-specific information from one caregiver to another for the purpose of ensuring the continuity and safety of the patient's care (Joint Commission Center for Transforming Healthcare, 2010). The term handoff is used interchangeably in literature with handover, sign-out, cross-coverage, shift report, shift-to-shift reports, change-of-shift reports (Aboshaiqah, 2010; Freitag & Carroll, 2011; Nelson & Massey, 2010) and endorsement (Freitag & Carroll, 2011). Handoff involves activities before handoff, during the handoff report, and after handoff.
- **Incoming nurse (Receiver)**: the nurse who receives critical information needed in order to safely care for the patient.
- **Non-digital artifact:** non-computerized tools or devices that are used to organize and coordinate work and maintain situation awareness among the team members, such as paper charts.
- **Outgoing nurse (Sender)**: the nurse who gives patients critical information to the receiving nurse.
- **Paperless documentation**: the use of electronic health records to document and communicate all aspects of patient care without the use of any paper charting system. This could include medications, diagnostic test, radiology, nursing procedure, etc., which might be used during handoff.
- **Quality handoff report**: the delivery of accurate, relevant, and up-to-date clinical information about the patient that are essential to ensure the continuity and safety of the patient's care.

- **Situation awareness**: a common understanding of patient's condition, present and past history, treatment, and the results of diagnostic tests that enable the nurse to assume patient care effectively.
- **Shift**: a scheduled period of time in which the nurses work to provide consistent care around the clock. In Oman, the nurses work three 8-hour shifts, whereas in some USA hospitals the nurses do two 12-hour shifts.

Chapter Summary

Handoff is an important aspect of shift work in a medical context, during which patients' clinical information and care responsibility are transferred to the incoming nurse, thus ensuring the continuity and quality of care. Handoff has been reported to be the leading cause of communication gaps among healthcare providers, leading to medical errors. Nurses use a variety of artifacts that help them maintain situation awareness about the current state of a patient's condition. The present study aims to examine the role of electronic health records, Al-Shifa, in supporting effective transition of care during handoff.

CHAPTER 2: LITERATURE REVIEW

Many researchers believe the goal of nursing handoff is to communicate and exchange accurate, relevant, and up-to-date clinical information about the patient which is necessary for continuity of care (Nelson & Massey, 2010; Pothier, et al., 2005; Strople & Ottani, 2006; Wilson, et al., 2009). Despite the importance of the nurse handoff process, research has shown this transition to be the leading cause for communication gaps, and increases the likelihood of adverse events (Groff & Augello, 2003; Joint Commission Center for Transforming Healthcare, 2010; Mistry, et al., 2010; Wears et al., 2003). The communication gaps are attributed to the fact that there are no communication and information transmission standards that govern the contents and the practices of handoff. For instance, there is no national policy in Western or Eastern countries that standardizes the information that nurses need to communicate during handoff. Additionally, current clinical information systems interfaces are not designed to structure and standardize handoff communication. The absence of structured policy and handoff communication tools lead to discrepancies in the amount and the quality of information exchanged during handoff and increase the occurrence of medical errors due to incomplete information or loss of information during the transition of care. Consequently, it is important to study the role of electronic health records in maintaining situation awareness about the current status of patient condition in the context of nursing handoff, particularly in contexts that are transitioning toward paperless documentation system.

2.1 Definition of Handoff

In healthcare settings, the provision of patient care is a continuous process that must continue across boundaries of time as healthcare practitioners change shifts thus, handoff becomes a critical part of shift work (Wilson, Galliers, & Fone, 2007). The Australian Commission on Safety and Quality in Health Care (2010, p. 4) defines the nurse handoff process as "the transfer of professional responsibility and accountability for some or all aspects of care for a patient, or group of patients, to another person or professional group on a temporary or permanent basis." The JCCTH (2010) later extended this definition to emphasize the process of passing patient-specific information from one caregiver to another for the purpose of ensuring the continuity and safety of the patient's care. To ensure the continuity of care across the shift change, effective communication systems that promote effective and efficient transfer of patient data among the nurses becomes critically important (Alvarado et al., 2006; Matic, et al., 2010; Olson, 2008; Wilson, et al., 2007). To date, nurses use a variety of handoff report methods with haphazard methods such as includes verbal, written, taped, or a combination of these methods. This, in turn, leads to ineffectiveness and subsequent medical errors.

2.2 Handoff Methods and practices

Over the years, the structures and the contents of the shift report have changed as leaders strive to manage the time and the effectiveness of the handoff (Olson, 2008). Traditionally, handoff reports are given at a common location where all the incoming and outgoing nurses collectively meet and the outgoing nurses take turns reporting about their patients. The actual delivery of handoff reports varies from one institution to another and in many cases it is either given verbally, in writing, via recording or a combination of

methods (Alvarado, et al., 2006; Caruso, 2007; Pothier, et al., 2005; M. Wilson, 2007). The recent trend in developed western countries has shifted from common room to one-to-one bedside handoff (Caruso, 2007; Chaboyer, McMurray, & Wallis, 2010; Griffin, 2010; McMurray, Chaboyer, Wallis, & Fetherston, 2010).

A meta-analysis by Strople & Ottani (2006) of handoff communication methods found that despite the increased emphasis of computing in healthcare systems, no studies employed a computer-generated handoff report. Similarly, Staggers & Jennings (2009) conducted an exploratory study in three U.S. hospitals where they examined the content and the context of handoff report, and the extent of nurses' use of electronic health records during handoff at medical and surgical units. To obtain in-depth information surrounding the handoff, the authors employed field observations, video recording and fieldnotes of fifty-three handoffs involving thirty-eight nurses. They found handoff to be a time-consuming process involving three phases: preparing the report, presenting the report, and clarifying the information presented. During all handoffs, they observed that no structured tools were used to standardize the contents of the handoff and most nurses used blank sheets of paper to make note of important information. In addition, most of the nurses relied on their internal memory rather than notes. Moreover, none of the nurses incorporated electronic health records during nursing handoffs. The authors attributed lack of use of electronic health record during handoff to the fact that electronic health records are not customized to fit the nurses' information needs during handoff.

Despite the lack of standardization, Welsh, Flanagan, & Ebrigh (2010) conducted a qualitative, descriptive study analyzing two handoff methods (written and taped nursing handoff) to compare information consistency using various methods. A convenience

sample of 30 nurses was recruited from general internal medicine, acute care/oncology, and surgical intensive care unit at a large Midwestern veteran's administration medical center. Data was collected using semi-structured interview with nurses from three shifts: day, evening, and night. All the interviews were tape-recoded and transcribed, and then were analyzed using a grounded theory approach. Two interviewers coded the data into three pre-identified categories: barriers, facilitators, and others. The result found the unstructured handoff report led to lengthy reports that included unnecessary or irrelevant information for patient care. The authors suggested standardizing handoff reports as means to reduce content omissions and disorganized reports. Thus, to achieve standardized handoff report, the authors emphasized the importance of identifying content and structure of handoff information.

2.3 Standardization of handoff

Olson (2008) conducted an extensive literature review of the factors leading to handoff communication failure, and found that lack of standardization in handoff communication format was the primary cause of handoff communication failure. Lack of standardization of handoff communication was found to contribute to disorganized handoff reports, lengthy handoffs, and inaccuracy of information communicated during handoff (Olson, 2008; Welsh, et al., 2010). The JCCTH (2010, p. 2) reported problems associated with lack of standardization of handoff communication that include "delay in treatment, inappropriate treatment, adverse events, omission of care, increased hospital length of stay, avoidable readmissions, increased costs, inefficiency from rework, and other minor or major patient harm."

The lack of handoff standardization led health and safety organizations around the world to develop guidelines and recommendations to improve handoff practices and resolve handoff related issues. For instance, the JCCTH has partnered with ten U.S. hospitals and health systems to address handoffs communication issues, which include finding the causes of miscommunication and implementing new practices such as using standardized handoff communication format (Joint Commission Center for Transforming Healthcare, 2010). As a means to standardize handoff communication, numerous mnemonics are used to provide structured handoff process for staff to follow during handoff. These verbal tools were found to improve the processes of handoff communication and promote consistency in information exchanges (Aboshaiqah, 2010; Leonard, et al., 2004; Riesenberg, Leitzsch, & Little, 2009).

The SBAR mnemonic (Situation, Background, Assessment and Recommendation) format was originally introduced in 2001 by Dr. Leonard, a physician leader for patient safety at Colorado Permanente Medical Group, to provide a common and predictable structure for healthcare professionals, so they may communicate and exchange patient care information effectively (Leonard, et al., 2004). Veltman & Larison (2007) conducted a literature review of mnemonics that are used to standardize communication among healthcare professionals and found SBAR to be the most popularly adapted method in the U.S. In a similar study, Riesenberg, Leitzsch, & Little (2009) performed an extensive literature review concerning handoff mnemonics that were written in English during the time period 1987 until 2008. They found that 24 mnemonics were in use to structure handoff communication practices. Of the methods employed, SBAR was reported to be the most frequently cited mnemonic (68 %).

Haig, Sutton, & Whittington (2006) reported the use of SBAR paper-based handoff form promoted consistent and effective communication during handoff, improving patient safety. In a similar study, Raines & Mull (2007) also found that the use of the SBAR handoff reporting format was helpful to remind healthcare providers with the information they need to share during handoff leading to clear, concise, and focused information exchange. SBAR has been proven to be especially effective communication tool in acute care settings that structure communication among nurses (Velji et al., 2008). In a recent study, Dunsford (2009) adapted SBAR to structure verbal handoff communication among nurses in acute care settings, which was reported to promote effective communication and information transfer across shifts.

2.4 Consequences of lack of handoff standardization

Shift changes have long been viewed as a leading cause for failures in the transfer of information, authority, or responsibility that can result in adverse events (Leonard, et al., 2004; Wears, et al., 2003). Nurses were reported to rely heavily on their memories when giving handoff reports, due to lack of a standardized handoff communication format, which greatly contributed to incomplete information or loss of information (Groff & Augello, 2003; Matic, et al., 2010; Olson, 2008). For example, Bomba & Prakash (2005) studied medical doctors' handoff processes at an Australian public hospital. They noticed the doctors used their memory or written notes to remind them of patient information, but none of them used a computer or a portable device to save patient information. The reliance on memory during the verbal exchange of information during handoff was reported to increase the likelihood of information loss or the transfer of incomplete or inaccurate data, ultimately increasing the risks of making medical errors

(Groff & Augello, 2003; Olson, 2008). According to the most recent report by the Joint Commission, it is estimated that 80 % of serious medical errors in the United States have been attributed to breakdown in communication during handoff (Joint Commission Center for Transforming Healthcare, 2010).

Pothier, et al.(2005) conducted a quasi-experimental study that examined the effectiveness and the reliability of three handoff methods: verbal, written, and sheet. A convenience sample of five nurses was recruited from the Ear, Nose and Throat Ward at St. Michael's Hospital, Bristol, UK. Three common handoff techniques were used to hand-off twelve cases on a one-to-one basis. During the verbal report, the outgoing nurse was asked to hand-off the patients verbally, yet the incoming nurse was not allowed to take notes. During the written report, the outgoing nurse was asked to hand-off the patients verbally, and the incoming nurse was permitted to take notes. During the sheet report, the incoming nurse was handed a typed sheet of paper that included detailed information about the patient followed by verbal reports. All the handoff reports were videotaped and were analyzed by three independent investigators who assessed the accuracy of the information communicated during handoff. They found the information loss among the three methods to be 91.4 % for the verbal report, 56.9 % for the written report, and 1.7 % for the sheet report.

Lack of standardized or structured handoff format has been reported also to contribute to lengthy shift reports, which exacerbate the problem of memory limitations. Staggers & Jennings (2009) conducted an exploratory study that examined the content and the context of handoff reports at medical and surgical units in three U.S. hospitals. The results confirmed handoffs to be time consuming as a result of the preparation for the

report, presentation of the report, and clarification of the information. The study also showed the average handoff report lasted from 16 to 28 minutes, with an average of 4.4 minutes per patient (Staggers & Jennings, 2009). Similarly, Benson, Rippin-Sisler, Jabusch, & Keast (2007) found the length of handoff report time-consuming, lasting 15-45 minutes on average.

Staggers & Jennings (2009) attributed lengthy reports to the fact that there are no structured tools for nurses to use during handoff. Welsh, et al. (2010) studied handoff methods where they found the unstructured handoff reports led to lengthy reports that included unnecessary or irrelevant information for patient care. In addition, they noticed that only a few nurses used the electronic health record to verify information received during handoff reports or augment the report when key elements were missing. When asked to identify the barriers to using electronic health record during handoff, the nurses stated that retrieving information from the electronic health record is time consuming because the electronic health records are not customized to fit the context of nursing handoff (Welsh, et al., 2010). As such, one might argue problems with handoffs may worsen because electronic health records interfaces are not designed to fit the nurses' informational needs during handoff.

Despite the initial studies that document the limitations of current clinical information systems, two studies have reported the use of electronic health records during handoff to be advantageous, enabling healthcare professionals access up-to-date clinical information about the patient, and to perform targeted information seeking and brief examination of patients' records before assuming patient-care responsibility (Hilligoss, 2010; Robles, 2009). In addition, the use of electronic health records helped healthcare

professionals to construct situation awareness about the patient condition, and treatment received, thus promoting interaction during the transition of care (Hilligoss, 2010; Robles, 2009).

2.5 Frameworks

2.5.1 Theory of distributed cognition

The theory of distributed cognition is a potential framework for studying the sociotechnical work of health care (Hazlehurst, McMullen, & Gorman, 2007), which helps to inform the design of interactive work "artifacts" (Hollan, Hutchins, & Kirsh, 2000). The theory of distributed cognition was developed by Edwin Hutchins after an extended cognitive ethnography of navigation aboard U.S. Navy ships to explain the sociotechnical interaction among nurses and the artifacts that the nurses used in the context of nursing handoff. (Hutchins & Lintern, 1995). As such, he theory of distributed cognition serves as a framework to analyze cognitive processes of end-users of technology (Hutchins & Lintern, 1995; Inoue, Aoyama, Kanno, Furuta, & Nakata, 2008) and their interactions with artifacts (Hutchins & Lintern, 1995). Unlike other cognitive theories, the theory of distributed cognition studies the cognitive process beyond the individual level to include individuals and their interactions with resource and material "artifacts" in the surrounding environment (Hollan, et al., 2000; Hutchins & Lintern, 1995).

According to the theory of distributed cognition, it is important to note that team members have different knowledge and different information resources that contribute to constructing situation awareness, a state in which the individuals comprehend the situation in order to make an appropriate decision (Artman & Garbis, 1998). Wilson, et al., (2009) applied the theory of distributed cognition to explain the sociotechnical

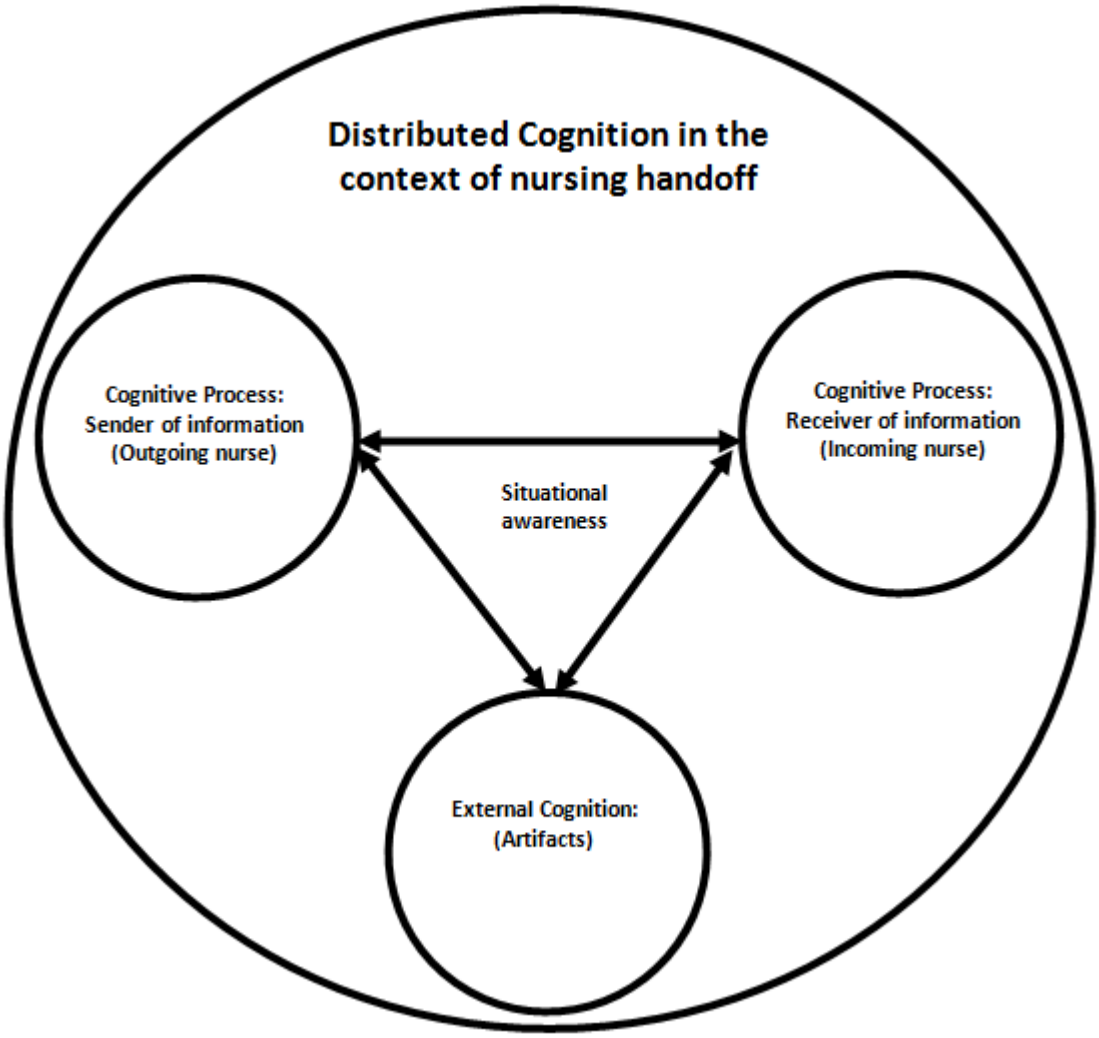
interaction among nurses and the artifacts that the nurses used in the context of nursing handoff. As a result, formulating situation awareness in the context of nursing handoff involves an ongoing process of communication and information exchange that empowers the nurses to jointly plan and prioritize care for individual patients (Wilson, et al., 2009). The information exchange during handoff is distributed around two cognitive systems: the external cognitive system "artifacts" and the cognitive process of the staff (Wilson, et al., 2009). Normally, the exchange of information between the sender and the receiver happens verbally during a handoff meeting or by reference to external cognitive artifacts such as nursing notes or technology (Wilson, et al., 2009).

The theory of distributed cognition has also been adapted to study cognitive process and situation awareness among the team members in a variety of sociotechnical contexts. For instance, Inoue et al.(2008) applied the theory of distributed cognition to study air traffic controllers' cognitive process and their situation awareness at Tokyo Area Control Centre. The study found that verbal communication plays an important role for cooperative work which enables team members to exchange various kinds of information and thus team members maintain situation awareness about air traffic. In another study, Ferruzca, Fabregas, & Monguet (2007) applied the theory of distributed cognition to study an activity system that is used in the design of a learning system for a distance course about mental health. In this study, interviews as well as questionnaires were used to gather the perceptions of system designers regarding the effectiveness, the ease of use and the efficiency of the system. Their findings indicated distributed cognition is a useful instrument for the analysis of systems, which offers suggestions

about how to change the design of an artifact to improve the users' performance or a work practice.

Figure 1.1, summarizes the findings of the literature review of distributed cognition and nursing handoff. As depicted in figure 1, the nurses rely on three constructs to formulate situational awareness about the current status of patient in the distributed cognition of nursing handoff. The proposed model include the cognitive process of the sender of information (outgoing nurse), the cognitive process of the receiver of information (incoming nurse), and external cognition (artifacts). In the distributed cognition of nursing handoff, the external cognition encompasses digital artifacts and non-digital artifacts that the nurses use. The digital artifacts include any computerized systems such as electronic health records. Digital artifacts facilitate organization and communication of patient care information. In addition, digital artifacts coordinate work among the multidisciplinary team of professionals, promote situation awareness about the current status of patient, and enable joint planning of patient care.

Figure: 1.1 Distributed cognition in the context of nursing handoff.



The non-digital artifacts include non-computerized tools or devices, such as whiteboards, that are used to organize and coordinate work and maintain situation awareness among the team members. In many hospital units, whiteboards are used to display important information that facilitate communication and coordination of care among multidisciplinary teams of professionals, especially during shift change. Situation awareness is an important aspect of teamwork in the clinical setting that helps the team members create a joint understanding of the patient's current condition and the tasks the incoming nurses need to accomplish in the subsequent shifts (Groff & Augello, 2003).

However, no study has looked at the role of electronic health records as a digital artifacts and its role in in enhancing the situational awareness between the sender and the receiver of information in the distributed cognitive system of handoff.

Application of distributed cognition in the context of handoff

Wilson, et al. (2007) studied the role of non-digital cognitive artifacts -- Microsoft Word handoff sheet and a doctors' book -- to support medical shift handoff at one pediatric and one medical ward in a U.K. hospital. Ethnographic observation, semi-structured interviews, and artifact analysis were used to obtain information concerning the extent these cognitive artifacts were used in supporting handoff. These artifacts were found to facilitate communication and coordinated work between medical staff that enhanced situation awareness during handoff. They found the use of the handoff sheet to be problematic. For example, updating information manually into the handoff sheet was laborious, and the information could be easily lost, especially when completed jobs were deleted from the electronic Microsoft Word document. In addition, they found problems with using doctors' book, such as the lack of space for each patient that resulted in messy and illegible handwriting, the book being too cumbersome to carry around, and the entries taking too long to write. The authors of this study highlighted the need for studying the impact of digital artifacts, such as electronic health record, in supporting teams' situation awareness.

In a similar study, Wilson et al., (2009) researched information sharing during clinical handoff as a way to promote situation awareness among the medical and nursing staff in the distributed cognitive system of the clinical setting. In their study, a variety of data collection methods were used, including ethnographic observations, fieldnotes, audio-recorded handoff reports, and informal interviews, which took place at six medical

and surgical wards in six U.K. hospitals. They found handoff variably differed from one institution to another in term of information content, supporting artifacts, participants, location, and duration of handoff. . In addition, due to lack of standardization the authors noticed the nurses encountered difficulty in locating information across the range of different artifacts, and sometimes the information captured in these artifacts was incomplete, out-of-date, or inconsistent with the verbal report. Similarly, lack of standardized handoff format led the nurses to spend a vast amount of their time during handoff maintaining their own and others' situation awareness, most of which was maintained verbally through asking questions, answering questions and telling each other what to do (Wilson, et al., 2009). Others studies have shown that effective handoff communication an essential factor that enabled the incoming nurse to develop a situational awareness about the patient's condition, current treatment, tasks that needed to be done, and events that are likely to occur during the incoming shift (Haig, et al., 2006).

Wilson, Galliers, & Fone (2006) did an experimental study examining the impact of shared artifact, by displaying the written handoff summary on LCD projector, on the collaborative work among medical doctors during handoff. In this study, ethnographic observation along with survey questionnaire and unstructured interviews were used to study doctors' interaction with the artifact, and information sharing during handoff. They found the shared artifact -- the written handoff summary presented on LCD projector -- provided a shared visual representation of information that allowed the team members to clarify missing information, which promoted situation awareness and decreased the cognitive load of the incoming team.

Application of distributed cognition in medical context

The theory of distributed cognition has also been used in the medical context to study the effect of cognitive artifacts in promoting communication, collaboration, and situational awareness among a wide range of professionals. For example, Xiao, et al., (2001) studied distributed cognition in healthcare facilities and focused on the use of non-digital whiteboard in a trauma center to maintain teams' distributed cognition. In this study, the status representation displayed on the whiteboard was reported to facilitate teams' situation awareness that helped in joint planning and decision-making.

In another study, Nemeth (2003) focused on the use of cognitive artifacts that were used to support distributed cognition among the critical care team members in acute care settings. The findings indicated that numerous non-digital cognitive artifacts were used to help the team members manage information and facilitate the coordination of care among the multidisciplinary team members including: "Block Schedule," "staff schedule," "daily availabilities," "master schedule," "the operation room whiteboard," and "the operation room graph." However, since these artifacts are non-digital they were found to be less interactive and more difficult to access and update information (Nemeth, 2003).

In a similar study, Nemeth, Cook, O'Connor, & Klock (2004) studied the use of cognitive artifacts among multidisciplinary teams of healthcare professionals in the operating room (OR). They examined the coordination and scheduling of patient care using non-digital artifacts such as the OR master schedule and OR board. The authors of this study emphasized the importance of medical informatics for the development of digital cognitive artifacts that support effective organization, management, and use of health care information systems. In addition, they have identified six elements of an

effective digital cognitive artifact for healthcare professionals; namely, the artifact must be accurate, efficient, reliable, informative, clear, and malleable (C.P. Nemeth, et al., 2004).

2.5.2 Technology Acceptance Model

Because the empirical research has shown that electronic health records do not currently support situational awareness, further investigation is needed to understand user perceptions. The Technology Acceptance Model (TAM) (Davis (1986, 1989) is one means used to assess the users satisfaction about the usefulness and ease of use of the information systems in a variety of sociotechnical contexts. The TAM model is an established tool that measures the usage and the acceptance of new technology, attaining Cronbach's alpha reliability estimate of .97 for perceived usefulness and .86 for ease of use (Davis, 1989). Formerly, the TAM model has been shown to be reliable and valid in investigation of the acceptance of electronic health records among health professionals (Chau & Hu, 2001; Chismar & Wiley-Patton, 2003; Dansky, Gamm, Vasey, & Barsukiewicz, 1999; Stocker, 2010; Yarbrough & Smith, 2007).

Additionally, TAM model had been adapted to study the acceptance of other clinical information systems. For instance, Sachidanandam (2006) applied the technology acceptance model to study the perceived useful and easy to use of Computerized Physician Order Entry (CPOE) system among 100 physicians at a U.S. hospital. The TAM was found to be a robust tool to predict the physicians' acceptance of the CPOE system. The study found that the perceived usefulness of the system to be an important predictor of their actual use of the system, when compared to the system ease of use. At a different study Kowitlawakul (2008) adapted technology acceptance model to study the

nurses' acceptance of telemedicine technology (eICU) at the critical care units of two healthcare systems in Virginia. A convenience sampling method was used to recruit 117 nurses to fill-in a survey questionnaire. She found that TAM was able to predict the intention to use the eICU® technology system in the nursing population. In addition, perceived ease of use was found to be the main factor that increased attitude toward using technologies.

2.5.3 SBAR Handoff Communication Format

SBAR handoff communication format was originally introduced in 2001 by Dr. Leonard, a leading physician for patient safety at Colorado Permanente Medical Group, to provide a common structure for healthcare professionals to communicate and exchange patient care information (Leonard, et al., 2004). SBAR has been proven to be an effective communication tool in acute care settings that structures communication among nurses (Velji et al., 2008). Raines & Mull (2007) have implemented a SBAR handoff-reporting format, which was found to positively improve the performance and satisfaction of both the sender and receiver of nursing report. In a similar study, Dunsford (2009) adapted SBAR to structure verbal handoff communication among nurses in acute care settings, which was reported to promote effective communication and the transfer of information across shifts.

Chapter Summary

Handoff is an essential element of shift work in health care settings, during which patient care responsibility and information is transferred to the incoming nurse. For an effective and efficient handoff to take place, it is important to have a standardized handoff communication system that guides the staff with the information that needs to be communicated during handoff. In practice, the nurses use variety of handoff report methods that includes verbal, written, taped, or a combination of these methods. However, to date, there is no established electronic handoff communication system that is integrated into the patient electronic health record. Consequently, this has led many patient safety organizations to develop standardized handoff communication tools, such as SBAR communication checklist(Leonard, 2004).

CHAPTER 3: METHODOLOGY

This chapter explains the research design of the present study that aims to: 1) assess the nurses' satisfaction with the usefulness and ease of use of the Electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff ; 2) explore the content and the context of handoff practice in Oman; 3) identify the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure continuity of care and the delivery of quality handoff report; and 4) identify the strengths and the weaknesses of the electronic health records in supporting quality handoff report. The chapter describes the research setting, research design, sampling procedures, data collection methods, and analysis procedures.

Table 3.1 summarizes the aims of the study corresponding to the research questions, hypotheses, and the data collection methods employed in this study.

Table: 3.1 Aims, research questions, hypotheses, and data collection matrix

Phases	Aims	Research questions (RQs)	Data Collection methods
Phase I	1) Assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff	RQ1. How satisfied are nurses with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff?	Survey
Phase II	2) Explore the content and the context of handoff practice in Oman.	RQ2. What is the content and the context of nursing handoff in Oman?	Interview & Observation
Phase II	3) Identify the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure continuity of care and the delivery of quality handoff reports.	RQ3. What digital and non-digital artifacts do nurses use to convey information between shifts and maintain distributed cognition among the health team members during handoff, and how are these artifacts integrated into the handoff reports?	Survey, interview, observation, & artifact analysis
Phase II	4) Identify the strengths and the weaknesses of the electronic health records in supporting quality handoff report	RQ4. What are the strengths and the shortcomings of the Electronic health records in supporting quality handoff reports during nursing handoff?	Survey, interview, observation, & artifact analysis

3.1 Research Setting

The study took place in the Sultanate of Oman, a Middle-Eastern country. The current trend in Oman is to move towards the implementation of a digital strategy, entitled "e-Oman". This project was initiated in 2003 and includes multifaceted strategies, among e-health initiatives (Al-Busaidy & Weerakkody, 2009). The e-health application, called Al-Shifa, is an in-house health information management system designed by the Oman's Ministry of Health (see Appendix Q).The current health policy in Oman mandates the implementation of paperless documentation systems such that all aspects of patient care are documented and communicated electronically using Al-Shifa (Al-Maqbalim M. R., personal communication, January 2011). Al-Shifa is currently used in nearly all the Ministry of Health healthcare institutions in Oman (Al-Maqbalim M. R., personal communication, January 2011).

3.2 Research Design

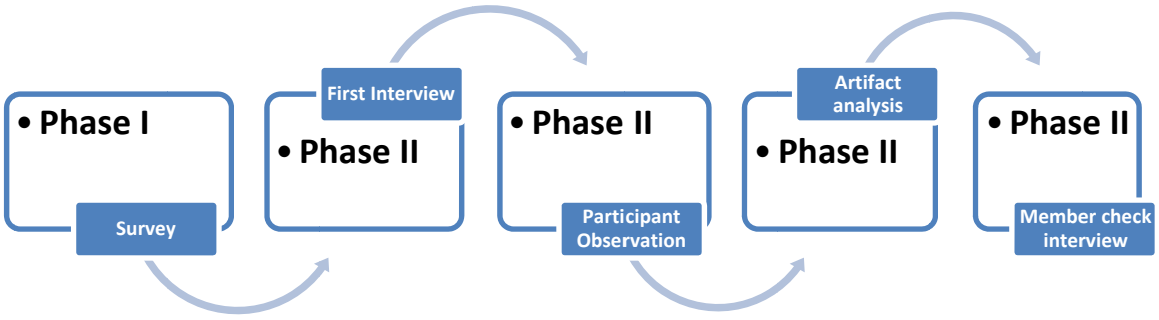
This study was conducted at the Royal Hospital, a tertiary-teaching hospital located in Muscat, the capital of Oman. The Royal Hospital is largest hospital in Oman, which is 630-bed hospital, and staffed with 1,324 nurses working on different units (The Royal Hospital, 2010).

A mixed-method, quantitative and qualitative, approach was used to study the nurses' acceptance of the electronic health records in structuring handoff communication, and to explore the handoff practices in Oman and the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure continuity of care and the delivery of quality handoff reports. Former studies of handoff and distributed cognition often used multiple data collection methods, such as surveys, interviews, artifact analysis, participant observations, and audio recordings (Benham-

Hutchins, 2008; Hollan, et al., 2000; Inoue, et al., 2008; Kerr, 2002; Nemeth, 2003; Nemeth, Klock, O'Connor, & Cook, 2004; Nemeth, O'Connor, Klock, & Cook, 2006; Nemeth, Wears, Patel, Rosen, & Cook, 2010; Olson, 2008; Wayne et al., 2008; Wilson, et al., 2007; Yee, Wong, & Turner, 2009).

As depicted in figure 3.1, this study consisted of two phases studying handoff practices among nurses in Oman. During Phase I, a survey questionnaire was used to assess the nurses' perception about the usefulness and ease of use of electronic health records for nurses during handoff as well as to obtain preliminary information about the practice of nursing handoff in Oman. During Phase II of the study, a variety of data collection methods were used to collect in-depth information surrounding nursing handoff that includes semi-structured interviews, artifact analysis, and participant observation.

Figure: 3.1 Sequence of data collection methods



3.3 Phase I: Quantitative Data

The first phase addressed the primary goal of the study, which sought to assess the nurses' satisfaction with the usefulness and the ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff.

3.3.1 Survey Questionnaire

During this phase of the study, a survey questionnaire was used to obtain preliminary information about the practice of nursing handoff in Oman and to assess the nurses' perception about the usefulness and ease of use of electronic health records for nurses during handoff. The literature review was used to inform the elements of the survey questionnaire. The survey questionnaire had 44 questions, all of which but one were close-ended questions. The last question was an open-ended question asking the nurses about the changes they would like to see in the design of Al-Shifa to better serve the nurses' information needs during handoff (see Appendix A).

The survey questionnaire consists of six sections: 1) perceived usefulness of the electronic health records during handoff, 2) perceived ease of use of the electronic health records during handoff, 3) the process and the practice of nursing handoff, 4) the perceived quality of nursing handoff, 5) the design of the electronic health records, and 6) nurses' demographic information.

Questions 1 – 12 were adapted from the Technology Acceptance Model (Davis, 1986, 1989) and were used to assess the nurses satisfaction with the electronic health records in supporting quality handoff report, as well as addressing the hypothesis of the study. Permission to adapt the TAM was obtained from Dr. Davis and appears in Appendix Y. The TAM is an established tool that measures usage and acceptance of new

technology, attaining Cronbach's alpha reliability estimate of .97 for perceived usefulness and .86 for ease of use (Davis, 1989). This study uses the TAM model five-point Likert scale to assess the nurses' satisfaction with the electronic health records, which is a determinant of their usage of the electronic health records during nursing handoff.

Questions 13 - 15 are designed to obtain preliminary data about the process and the practice of handoff. Questions 16 - 27 are designed to assess the perceived quality of handoff report. Questions 28 - 32 are designed to illicit participants' response about the system design and the training they have received. Finally, questions 33 - 43 solicit demographic information about the nurses, including gender, age, duration of service, level of education, and computer skills. These factors were used as independent variables in this study.

3.3.2 Sampling

During Phase I of the study, 259 nurses met the following inclusion criteria; nurses working at Male Medical I, Male Medical II, Female Medical I, Female Medical II, Male Surgical, Female Surgical, Oncology, and Nephro-Urology units. Nurses working at the other units were excluded from this study because they work on either one-to-one patient assignment, the severity of patient condition, or nurses work day shift only. Raosoft sample size calculator (Raosoft, 2004) was used to determine sample size. The target number of 155 nurses was needed to achieve a significant statistical result at the 95 % confidence level.

3.3.3 Survey data collection procedure

A total of 300 survey questionnaires along with a cover letter explaining the scope, aims, and procedures of the study were handed to the Education and Training

Department at the Royal Hospital, which were then distributed by the Nursing Administration office to all the registered nurses working at the medical, surgical, nephro-uro and oncology inpatient units (N =259). Flyers explaining the scope, aims and the procedures of the study were also posted at the medical, surgical, nephro-uro and oncology inpatient units (see Appendix E). The participants were presented with a detailed written instruction about the study and they were asked to sign a consent form indicating their voluntary participation in the study. The participants were given one month to complete the survey, effective September 26, 2011 to October 27, 2011. They were instructed to return completed questionnaires to the Education and Training Department. All completed questionnaires were kept in a locked dropbox at the Education and Training Department. Of the 259 nurses who met the inclusion criteria, 167 responded to the survey. Ten of those surveys contained no data, yielding a 60.6 % response rate. As an incentive for participating in the study, the participants who completed the survey were included in a raffle draw to win an Apple iPad 2nd generation 16GB with Wi-Fi.

3.3.4 Survey data analysis

Data obtained from the survey questionnaire were reformatted in preparation for analysis, and were then entered into IBM SPSS version 19. Prior to the data analysis, the data was first screened for missing data. Next, the validity and reliability of the instruments used in this study were examined before the analysis. Then, variables were examined for normality and linearity assumptions. Descriptive and frequency statistics were run to understand the frequency and tendency of nurses' demographic data and their perception about the current handoff process and practices.

3.4 Phase II: Qualitative Data

Phase II of the study addressed the second, the third and the fourth aims of this study, which were geared toward exploring handoff practices in Oman, identifying the artifacts that the nurses use to construct situation awareness, and identifying the strengths and the weaknesses of the electronic health records in supporting quality handoff report. During this phase of the study, a variety of data collection methods were used to collect in-depth information surrounding nursing handoff that includes semi-structured interviews, artifact analysis, and participant observation. Findings of this phase were used to validate the information obtained from the survey questionnaire, as well as to explore the content and the context of nursing handoff in Oman, to identify the artifacts that the nurses use to maintain teams' situational awareness, and to explore the potential opportunities for system redesign to better fit the context of nursing handoff. Particular emphasis was placed on the use of digital artifacts, electronic health records, and their role in maintaining situation awareness among the team members in the distributed cognitive system of handoff.

3.4.1 Semi-structured interview

The researcher used the findings of the literature review to inform the elements of the semi-structured interview guide (see Appendix B). Formerly, the interview guide was found to provide a consistent framework to explore, probe, and ask questions that elucidate and illuminate subject of interest (Patton, 2002).

To design a technology that supports the handoff practices, Randell, Wilson, Woodward, & Galliers (2011) suggested the systems designer should gather preliminary information about handoff processes and practices that include the following:

- Where does the handoff take place?
- Who participates in the handoff and to what extent?
- How the handoff report is structured?
- What information does the handoff contain?
- What order is used to present this information?
- What artifacts do nurses currently use to support the handoff?
- What is the nature of the communication that takes placed during handoff?

Thus, the current study incorporated most of these elements into a semi-structured interview guide that was used to elicit in-depth information about the:

- Typical nursing handoff.
- Al-Shifa use before, during, and after handoff.
- Artifacts the nurses use to communicate and exchange information during handoff.
- Features or functionalities in Al-Shifa that are helpful for nurses during handoff.
- Features that are missing from Al-Shifa that maybe helpful for nurses during handoff.
- Suggested changes in the handoff process and practice.
- Suggested changes in the design of Al-Shifa to promote effective and efficient transfer of patient information during handoff.

A purposeful sample of 14 nurses was randomly selected for semi-structured interview from a pool of 20 nurses who self-selected to participate in the second phase of the study. Each participant was interviewed twice. The first interview lasted from 20 – 30 minutes and took place prior to observation, and the second interview was scheduled within two weeks of the first interview. All the participants were presented with a written consent form explaining the scope of the study and indicating their participation in this study is voluntary (see Appendix B). Participants were assured if they did not want to participate; they could leave the study at any time, with no resulting penalty or loss of work benefits.

During the interviews, the researcher documented short notes, which were later used to probe the interviewee for further explanation. All individual interviews took place in a private room and were recorded using a digital voice recorder for later analysis. The interviews were transcribed within two weeks of the interview, and the digital files were deleted immediately after transcription. A code key was assigned to each participant, which was then encrypted and kept in a secure location. A second interview was conducted within two weeks of the first interview. The second interview was designed to member check with the participants as a step to confirm the findings and interpretations drawn from the first interview and the observations. During the member check interview, the participants were shown a transcript of the first interview and were asked to review the transcript, clarify any missing information, and disregard any information that the researcher may have misinterpreted. Member check interviews enabled the researcher to validate the findings and interpretations drawn from the first interview and observation; as a step to ensure the trustworthiness of the findings (Patton, 2002).

3.4.2 Naturalistic Observations & Artifact analysis

Handoff observations coupled with fieldnotes were used to collect data about the process and the contents of nursing handoff involving selected nurses in various shifts. Twenty nursing handoffs were randomly observed at four units across the three shifts: morning, afternoon and night, including holidays and weekends. A predefined observation checklist, adapted from the SBAR handoff communication format, was used to guide the researcher to identify, categorize, and cluster the information communicated during nursing handoff (see Appendix C). To gain a holistic picture about the key events and activities taking place before, during and after handoff, the researcher arrived on the ward one hour prior to the arrival of the incoming shift, attended the handoff report and observed one or two members of the incoming shift an hour after they received the handoff report. Coming an hour before the beginning of the shift and staying an hour after the shift enabled the researcher to observe the nurses' use of the electronic health records, as well as provided opportunity to clarify the information obtained surrounding handoff. Patton's (1990) scheme for analyzing observations was used to organize the data obtained during observations and fieldnotes, which included: description of the setting and the context of nursing handoff, the participants' involvement during handoff, the duration of handoff, the artifacts the nurses used, and how these artifacts were integrated into handoff report. A digital camera was used to capture images of artifacts the nurses used to promote situational awareness in the distributed cognitive system of handoff (see Appendix J to P).

3.4.3 Qualitative Data Analysis

All information obtained during the second phase of the study was imported and annotated using NVivo. NVivo enabled the researcher to organize and analyze the data and assign themes in a more efficient way, such as using the drag and drop feature of NVivo that enabled the researcher to triangulate the data obtained from different sources into the corresponding themes. In NVivo, the qualitative data were analyzed using Clark & Creswell's (2010) five steps for analyzing qualitative data as below:

- Preparing data for analysis.
- Exploring the data.
- Analyzing the data.
- Representing the data analysis.
- Interpreting the results.

During the first step -- preparing data for analysis -- the researcher at the end of each interview and observation spent time organizing the data, filling-in incomplete data, cleaning the data, and creating a log table that included the date, place of observation, activity, participant involved, and data sources. Additionally, all the interviews were transcribed within two weeks of the interview and the digital files were deleted immediately after transcription. A member check interview was scheduled within two weeks of the first interview during which the participants were shown a transcript. The participants were allotted 24 hours to review the transcript and were asked to read the findings and interpretations drawn from the first interview and observation, which enabled the researcher to ensure the trustworthiness of the findings. Once the transcript was member checked, the final transcription was imported into NVivo along with the

data obtained from observation and artifact analysis. During the second step -- exploring data -- the researcher reviewed the raw data, wrote side memos, and developed a qualitative codebook. During the thirds step -- analyzing the data -- the researcher read the sentences and phrases and assigned labels based on the codebook (see Appendix X). Patton's (2002) inductive analysis approach was used to code these labels into broader themes that include:

- Typical nursing handoff.
- Al-Shifa use surrounding nursing handoff.
- Artifacts the nurses used to communicate and exchange information between shifts.
- Information usually communicated during handoff.
- Features or functionalities in Al-Shifa that are helpful during handoff.
- Features that are missing from Al-Shifa that maybe helpful during handoff.
- Suggested changes in the handoff process and practice.
- Suggested changes in the design of Al-Shifa to fit the nurses' informational needs during handoff.

During the fourth step -- representing the data analysis -- the researcher discussed the evidence for the themes, such as specific participant statements, and providing visual representation of the findings, such as figures or tables that present the different themes. Despite the fact that the interviews were conducted on a one-to-one basis, the researcher noticed that some of the nurses were talking in the first person, whereas some other nurses were talking in the third person, especially the in-charge nurses. These differences

will be noticed in statements that are quoted in this dissertation study. During the fifth step -- interpreting the result -- the researcher explained how the research questions were answered by the qualitative findings and brought in his personal nursing and informatics experience to draw meaningful conclusions and recommendations.

3.5 Research Quality

3.5.1 Expert Review

To ensure the quality of the quantitative data, the survey questionnaire was presented to two subject matter experts, including a senior staff nurse and medical-surgical clinical instructor. Each reviewed the survey questionnaire to ensure the instrument content validity as well as to ensure the format of the questions was readable, understandable, and comprehensive. Using Qualtrics online surveying site, textboxes were added beside each question for the reviewers to use in case the questions were not clear. None of the questions were found to be difficult to understand. Additional questions pertaining to the process and the practice of nursing handoff in Oman were suggested by the reviewers, which then incorporated into the survey questionnaire.

3.5.2 Pilot test

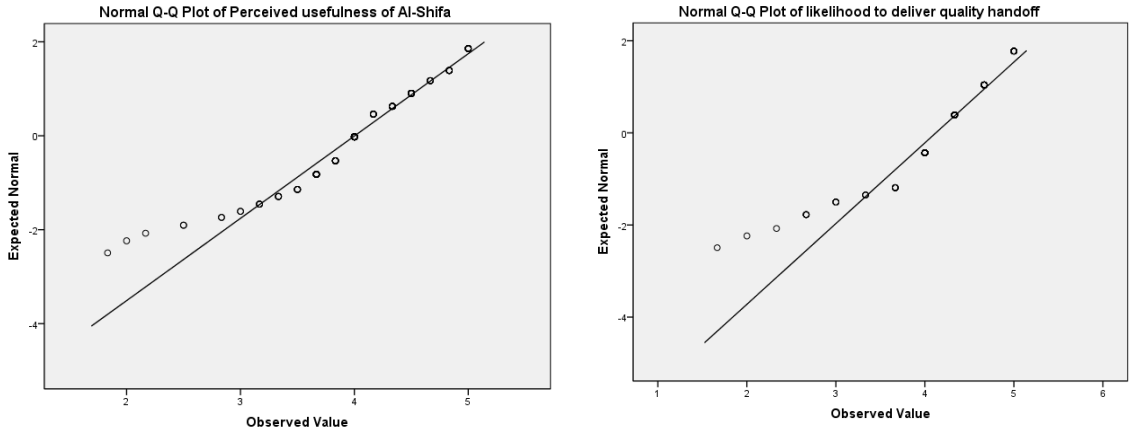
Following the subject matters review, the survey instrument was pilot tested. A convenient sampling method was employed to recruit five nurses to take the Qualtrics online survey questionnaire. Participants' email addresses were used to assign permission to take the online survey. The participants were told that the survey was timed, and they were instructed to complete the survey once they launched the survey. Findings of the pilot study enabled the researcher to estimate the time it takes to complete the survey. In addition, it enabled the researcher to ensure the formatting of questions is readable,

understandable, and comprehensive. Participants suggested converting the online survey to a paper-based survey questionnaire and suggested adding the term “handover” and “endorsement”, which are the terms that are interchangeably used to describe handoff in Oman.

3.5.3 Data screening

Data analysis began with screening the data for missing values. Out of the 259 nurses who met the inclusion criteria, 167 responded to the survey. Ten of those surveys contained no data, which were then deleted, yielding (N= 157, 60.6 %) response rate. Next, Shapiro-Wilk test and Q-Q Normal Plot were performed to examine the dependent variables for normality assumptions. According to the results of the assumptions testing, the Shapiro-Wilk test yielded Sig. value below 0.05 and the distribution of the data on the Q-Q Normal Plot does not follow a linear pattern, which indicate that the dependent variables have violated normality and linearity assumptions as suggested by Field (2009). In the interest of space, Q-Q plots for all variables are not presented here. However, representative example Q-Q plots are provided in figure 4.1. When data violates the assumptions of normality, Field (2009), recommends using a nonparametric tests, such as Spearman’s correlations.

Figure: 4.1 Representative Q-Q Plots



3.5.4. Validity analysis of the survey instruments

Factor Analysis was conducted to ensure the validity of the survey items (see Appendix H). When doing factor analysis, Kaiser (1970) suggests calculating Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) with an acceptable value greater than 0.5. Kaiser-Meyer-Olkin (KMO) test was used to verify the sampling adequacy for running factor analysis, KMO =.859. In addition, Bartlett Test of Sphericity X^2 (105) =1057.567, p=.000, indicating that correlations between items were sufficiently large for conducting factor analysis. As depicted in table 4.1, both the results of the Bartlett Test of Sphericity and the KMO Measure of Sampling Adequacy indicated the appropriateness of using factor analysis.

Table: 4.1 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.859
Bartlett's Test of Sphericity	Approx. Chi-Square	1057.567
	df	105
	Sig.	.000

In addition, when doing factor analysis, Stevens (2002) recommends an absolute factor loading of .4 and above for a sample size greater than 150. Varimax rotation analysis was used with a specified three-factor structure: perceived usefulness, perceived ease of use, and perceived quality of handoff reports. Varimax rotation attempts to maximize the dispersion of loadings with factors resulting in more interpretable clusters of factors (Field, 2009). Field (2009) suggests excluding items of a scale that exhibit many correlations below 0.3 with a factor loading below .4.

All the elements of the first construct, the perceived usefulness of the electronic health records for nurses during handoff (Q1-Q6), loaded within the range of .58 to .82. Similarly, the elements of the second construct, the perceived ease of the electronic health records for nurses during handoff (Q7-Q12), loaded nicely ranging from .6 to .77. However, the elements of the third construct, perceived quality handoff report, did not all load above .4. The Q24 had a factor loading .22 and the Q26 had a factor loading -.17. Thus, an inter-item correlation matrix was done to confirm the findings of the factor loading. All the elements of the scale yielded a significant correlation matrix above 0.3. However, Q24 & Q26 did not correlate well with the rest of the elements. Field (2009) suggest excluding items of a scale that has correlations below 0.3 with a factor loading below .4. As a result, Q24 & Q26 were dropped from the scale during analysis.

3.5.5 Reliability analysis of survey instruments

Cronbach's alpha was used to evaluate the internal consistency of the survey instrument. Cronbach's alpha of .7 is considered an acceptable measure of internal consistency (Cronbach, 1951). Thus, all the constructs were expected to have reliabilities greater than .7. As depicted in table 4.2, the findings of the reliability test before and after

dropping Q24 & Q26. Findings of the Factor analysis were used to justify the elimination of Q24 & Q26 from the scale yielding a more reliable tool, the Cronbach's α has improved from .54 to .75 for the perceived quality handoff report.

Table: 4.2 Reliability test before and after dropping Q24 & Q26 (N =157)

Constructs	# of items	Cronbach's α	# of items	Cronbach's α
Perceived usefulness	6	.84	6	.84
Perceived ease of use	6	.83	6	.83
Perceived quality handoff report	5	.54	3	.75

3.5.6 Triangulated data collection & analysis methods

Lincoln & Guba (1985) and Patton (2002) recommend using multiple data collection methods and sources as a means to check the consistency of the findings and to ensure the trustworthiness of the inquiry. Moreover, Lincoln & Guba (1985) suggest spending a long period of time in the field of study, collecting persistent observations, and using triangulated data collection methods to increase the credibility of the qualitative studies. Thus, the present study employed multiple data collection methods to study handoff in Oman. Naturalistic observations, semi-structured interviews, and artifact analysis were used to obtain in-depth qualitative data about the practice surrounding nursing handoff across the three shifts. Member check interviews were held with all the fourteen participants.

3.5.7 Member check

Member check interviews were used to validate the findings and the interpretations drawn from the first interview and hand observations. During the member

check interviews, the participants were presented with a transcript summarizing the findings obtained from the first interview, and they were given 24 hours to review the transcript. The participants were then asked to clarify any missing information and disregard any information that the researcher may have misinterpreted. Member check interviews enabled the researcher to ensure the trustworthiness of the findings.

3.6 Ethical Consideration

The proposal was evaluated, and approved by the University of Missouri Institutional Review Board committee (see Appendix F), and the Research and Ethical Review Committee at the Royal Hospital (see Appendix G). Permission to conduct the study was sought from the Nursing Superintendent at the Royal Hospital (see Appendix D). All the participants were presented with detailed written instructions about the scope, aims, and procedures of the study, and they were asked to sign a consent form indicating their voluntary participation in the study. Patient privacy and confidentiality were maintained throughout the study. For instance, all the digitally recorded interviews were transcribed verbatim and the digital files were deleted immediately after the transcription. Transcribed data were also aggregated and deidentified prior to the analysis, which ensures no staff identifiers were included in the actual transcript. Field observations and notes did not include any patient identifiers and the digital images of artifacts were distorted using Adobe Photoshop CS. All the data obtained from the interviews, field observations and digital images were imported into NVivo and were password protected using NVivo encryption feature.

CHAPTER 4: RESULTS

Introduction

The aims of this study were to assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff, explore the handoff practices in Oman, and identify the tools nurses use to construct a common understanding about patients' condition. This chapter starts with presenting the demographic characteristics of the study participants, followed by descriptive statistics, and the presentation of the results of the quantitative data analysis using the SPSS. Finally, this chapter presents the findings of the qualitative phase.

Phase I: Quantitative findings

Demographics of survey respondents

Out of the 259 nurses who met the inclusion criteria, 167 responded to the survey. Ten of those surveys contained no data, which were then deleted, yielding (N= 157, 60.6 %) response rate. Table 4.3 depicts the demographic characteristics of the survey participants. Most of the participants were female (N = 141, 89.8 %), while 10.2 % (N = 16) of the participants were male. There were 54.8 % (N = 86) non-Omani nurses and 45.2 % (N = 71) Omani nurses. The majority of the participants 77.1 % (N = 121) were over the age of 26, while only 1.3 % (N =2) were over the age of 56 (see table 4.2). For level of education, most of the participants 75.8 % (N = 119) had a basic nursing diploma, 12.7 % (N = 20) had a Bachelor's degree in nursing, and 11.5 % (N = 18) had a post-basic nursing diploma.

Most of the participants worked as a registered nurse 3-7 years 35 % (N = 55) and 8-12 years 35 % (N = 55), while 15.3 % (N = 24) worked as a registered nurse more than

18 years, and 10.8 % (N = 17) worked as a registered nurse for less than two year. Majority of the participants 51 % (N = 81) rated their computer skills to be very good, while 39.5 % (N = 62) to be fair, 7 % (N = 11) to be excellent, and only 1.9 % (N = 3) of the participants rated their computer skills to be poor. Most of the participants 80.3 % (N = 126) learned to give handoff reports in their nursing programs, while 19.7 % (N = 31) did not learn to give handoff reports in their nursing programs. Majority of the participants 56.7 % (N = 89) received formal in-service training on what to include in a nursing handoff, while 43.3 % (N = 68) did not receive formal in-service training on nursing handoff.

Table: 4.3 Demographic characteristics of the survey respondents (N =157)

Variables	Frequency	Percent
Gender		
Male	16	10.2
Female	141	89.8
Nationality		
Omani	71	45.2
Non-Omani	86	54.8
Age		
< 25	36	22.9
26-35	69	43.9
36-45	34	21.7
46-55	16	10.2
>56	2	1.3
Level of Education		
Basic Nursing Diploma	119	75.8
Post-Basic Diploma	18	11.5
Bachelor of Science in nursing	20	12.7
Number of years been RN		
< 2 years	17	10.8
3-7 years	55	35.0
8-12 years	55	35.0
13-17 years	6	3.8
> 18 years	24	15.3
Computer skills		
Poor	3	1.9
Fair	62	39.5
Very Good	81	51.6
Excellent	11	7.0
Studied handoff in nursing program		
Yes	126	80.3
No	31	19.7
Received in-service training on nursing handoff		
Yes	68	43.3
No	89	56.7

Research question 1 (RQ1)

The first research question assessed the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff. To answer this research question (RQ1), a Likert-type scale was adapted from the Technology Acceptance Model (Davis, 1989), with the responses of "1=Strongly Disagree," "2=Disagree," "3=Neither," "4=Agree," and "5=Strongly Agree".

Table 4.4 presents descriptive statistics relevant to RQ1. The findings indicated that the nurses had positive perceptions about the constructs of this study: perceived usefulness of Al-Shifa, perceived ease of use of Al-Shifa, perceived quality handoff report, and the reported usage of Al-Shifa during handoff. As depicted in table 4.4, the mean scores of the perceived usefulness of Al-Shifa for nurses during handoff was 4.00 (S.D = 0.57), the perceived ease of use of Al-Shifa for nurses during handoff was 3.99 (S.D = 0.49), the perceived quality handoff report when using the Al-Shifa during handoff was 4.12 (S.D = 0.57), and the reported usage of Al-Shifa during handoff was 3.44 (S.D = 1.22).

Table: 4.4 Descriptive statistics pertaining to constructs of the study

	N	Min	Max	Mean	Std. Deviation
Perceived usefulness of Al-Shifa during handoff	157	1	5	4.00	0.57
Perceived ease of use Al-Shifa during handoff	157	1	5	3.99	0.49
Perceived quality handoff report	157	1	5	4.12	0.57
Reported usage of Al-Shifa during handoff	157	1	5	3.44	1.22

The researcher is also interested to test for significant statistical difference among participants' demographics (N = 157) and the constructs of the study. As depicted in table 4.5, surprisingly the nurses' level of education did not show significant correlations with any of the constructs of the study. Age had a statistically significant positive correlation with nurses' level of experiences (r = 0.819, P =.000) and years of using Al-Shifa (r = 0.358, P =.000), and had a statistically significant negative correlation with the perceived ease of use of Al-Shifa during handoff (r = - 0.164, P =.040) and the nurses' computer skills (r = -.301, P =.000).

The nurses' level of experience had a statistically significant positive correlation with nurses' age (r = 0.819, P =.000) and years of using Al-Shifa (r = 0.415, P =.000), while nurses' level of experience had a statistically significant negative correlation with the nurses computer skills (r = -0.263, P =.001).

This section will also be used to address the findings pertaining to the four hypotheses had been proposed about the use of electronic health records during handoff. Findings of these hypotheses were used to answer the first research question: "How satisfied are nurses with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff." An alpha level of .05 and spearman's correlation tests were used to test the following four hypotheses for statistical significance:

1) There is a relationship between perceived usefulness of electronic health records and the likelihood of using them during handoff.
2) There is a relationship between perceived ease of use of electronic health records and the likelihood of using them during handoff.

3) There is a relationship between perceived usefulness of electronic health records and the perceived quality handoff report.
4) There is a relationship between perceived ease of use of electronic health records and the perceived quality handoff report.

The first hypothesis proposed a relationship between perceived usefulness of electronic health records and the likelihood of using them during handoff. A Spearman's Rank Order correlation was run to determine the relationship between perceived usefulness of electronic health records and the likelihood of using them during handoff. There was a small, positive correlation between perceived usefulness of electronic health records and the likelihood of using them during handoff, which was statistically significant (r= .38, P = .000).

The second hypothesis proposed a relationship between ease of use of electronic health records and the likelihood of using them during handoff. A Spearman's Rank Order correlation was run to determine the relationship between ease of use of electronic health records and the likelihood of using them during handoff. There was a small, positive correlation between ease of use of electronic health records and the likelihood of using them during handoff, which was statistically significant (r= .39, P = .000).

The third hypothesis proposed a relationship between perceived usefulness of electronic health records and the perceived quality handoff report. A Spearman's Rank Order correlation was run to determine the relationship between perceived usefulness of electronic health records and the nurses' subjective perception of the quality of the handoff report they receive. There was a moderate, positive correlation between

perceived usefulness of electronic health records and the perceived quality handoff report, which was statistically significant (r= .43, P = .000).

The fourth hypothesis proposed a relationship between perceived ease of use of electronic health records and the perceived quality handoff report. A Spearman's Rank Order correlation was run to determine the relationship between perceived ease of use of electronic health records and the nurses' subjective perception of the quality of the handoff report they receive. There was a small, positive correlation between perceived usefulness of electronic health records and the perceived quality handoff report, which was statistically significant (r= .26, P = .001).

Table: 4.5 Correlations between study constructs & participant's demographics

		Perceived usefulness	Perceived ease of use	Perceived quality handoff	Reported usage	Age	Level of experience	Years of using Al-Shifa	Level of education	Computer skills
Perceived usefulness	Correlation Coefficient	1.000								
	Sig. (2-tailed)	.								
	N	157								
Perceived ease of use	Correlation Coefficient	.451**	1.000							
	Sig. (2-tailed)	.000	.							
	N	157	157							
Perceived quality handoff	Correlation Coefficient	.429**	.263**	1.000						
	Sig. (2-tailed)	.000	.001	.						
	N	157	157	157						
Reported usage	Correlation Coefficient	.375**	.385**	.234**	1.000					
	Sig. (2-tailed)	.000	.000	.003	.					
	N	157	157	157	157					
Age	Correlation Coefficient	-.079	-.164*	-.002	-.028	1.000				
	Sig. (2-tailed)	.328	.040	.981	.731	.				
	N	157	157	157	157	157				
Level of experience	Correlation Coefficient	-.069	-.134	.060	.051	.819**	1.000			
	Sig. (2-tailed)	.392	.095	.456	.525	.000	.			
	N	157	157	157	157	157	157			
Years of using Al-Shifa	Correlation Coefficient	-.077	.008	.030	.125	.358**	.415**	1.000		
	Sig. (2-tailed)	.340	.918	.707	.119	.000	.000	.		
	N	157	157	157	157	157	157	157		
Level of education	Correlation Coefficient	.039	.028	.056	.070	.137	.127	-.087	1.000	
	Sig. (2-tailed)	.625	.725	.488	.382	.087	.112	.276	.	
	N	157	157	157	157	157	157	157	157	
Computer skills	Correlation Coefficient	.175*	.148	.199*	.100	-.301**	-.263**	-.043	.082	1.000
	Sig. (2-tailed)	.028	.064	.012	.212	.000	.001	.597	.307	.
	N	157	157	157	157	157	157	157	157	157

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Phase II: Qualitative findings

This section presents the findings of the qualitative phase relevant to the following three research questions:

RQ2. What is the content and the context of nursing handoff in Oman?

RQ3. What digital and non-digital artifacts do nurses use to convey information between shifts and maintain distributed cognition among the health team members during handoff, and how are these artifacts integrated into the handoff reports?

RQ4. What are the strengths and the shortcomings of the electronic health records in supporting quality handoff reports during nursing handoff?

Demographics of interview participants

Out of 157 participants who completed the survey, only 20 participants (31 %) self-selected to participate in the second phase of the study. A purposeful sample of 14 nurses from the 20 nurses was randomly selected for semi-structured interviews. Table 4.6 presents the demographic characteristics of the interview participants (N =14). Most of the participants were women 85.7 % (N = 12), while 14.3 % (N = 2) of the participants were men. The majority of the interview participants 50 % (N = 7) were 26-35 years old, while 21.4 % (N =3) were below the age of 25, 21.4 % (N =3) were 36-45 years old and 7.1 % (N =1) was over the age of 56. The majority of the interview participants 64.3 % (N = 9) had a basic nursing diploma, while 21.4 % (N = 3) had a post-basic nursing diploma and 14.3 % (N = 2) had Bachelor's degree in nursing. The majority of the interview participants worked as registered nurses 3-7 years 78.6 % (N = 11), while 14.3 % (N = 2) worked as registered nurse 13-17 years, and 7.1 % (N = 1) worked as

registered nurses more than 18 year. The majority of the interview participants 50 % (N = 7) rated their computer skills to be very good, while 42.9 % (N = 6) to be fair, and only 7.1 % (N = 1) rated their computer skills to be to be excellent poor.

Table: 4.6 Demographic characteristics of the interview participants (N =14)

Variables	Frequency	Percent
Gender		
Male	2	14.3
Female	12	85.7
Nationality		
Omani	9	64.3
Non-Omani	5	35.7
Role		
In-charge nurse (Charge nurse)	3	14.3
Registered nurse	11	78.6
Age		
< 25	3	21.4
26-35	7	50.0
36-45	3	21.4
46-55	1	7.1
Level of Education		
Basic Nursing Diploma	9	64.3
Post-Basic Diploma	3	21.4
Bachelor of Science in nursing	2	14.3
Number of years been RN		
3-7 years	11	78.6
13-17 years	2	14.3
> 18 years	1	7.1
Computer skills		
Fair	6	42.9
Very Good	7	50.0
Excellent	1	7.1

Summary of handoff observation

Handoff observations coupled with fieldnotes and semi-structured interviews were used to collect data about the process and the practice of nursing handoff involving selected nurses in various shifts. To gain a holistic picture about the key events and activities taking place before, during and after handoff, 20 nursing handoffs were randomly observed between October 2011 and January 2012. The observation took place at the Medical-Surgical and Nephrology Units that covered all the three shifts: morning, afternoon and night, including holidays and weekends (see Appendix Z).

As depicted in table 4.7, the researcher attended 20 nursing handoffs involving 162 nurses. During these handoff reports, 382 patients were included in the handoff reports. All the 20-handoff reports took place in a private room, where all the nurses of the incoming shift listened to the handoff reports of all the patients admitted in the unit. The length of the handoff report varied across shifts and units, ranging from 17 minutes to 90 minutes per shift. The descriptive statistics of handoff observations reveal the average handoff report was 38.60 minutes per shift, with an average of 2.07 minutes per patient. The nurses identified many factors that determine the length of the handoff report that include: the number of patients admitted in the unit, the severity of patient condition, and whether the nurses took care of the patient recently or not.

Table: 4.7 Descriptive statistics of handoff observations (N =20)

	Minimum	Maximum	Sum	Mean
Length of handoff report (time in minute)	17	90	772	38.60
Total observed outgoing nurses	1	6	65	3.25
Total observed incoming nurses	4	7	97	4.85
Total patients handed-off	10	27	382	19.10
Length of handoff per patient (time in minute)	.95	3.75	41.30	2.06

Research Question 2 (RQ2)

The second research question addressed the content and the context of the nursing handoff in Oman. Finding of this study revealed that the nurses in Oman use the term "endorsement" to describe the handoff report that takes place between shifts.

Background information about the content and the context of handoff

This aspect of the research presents the findings relevant to the second aim of the study that explores the content and the context of handoff practice in Oman. Findings pertaining to this research question are presented in the following sequences:

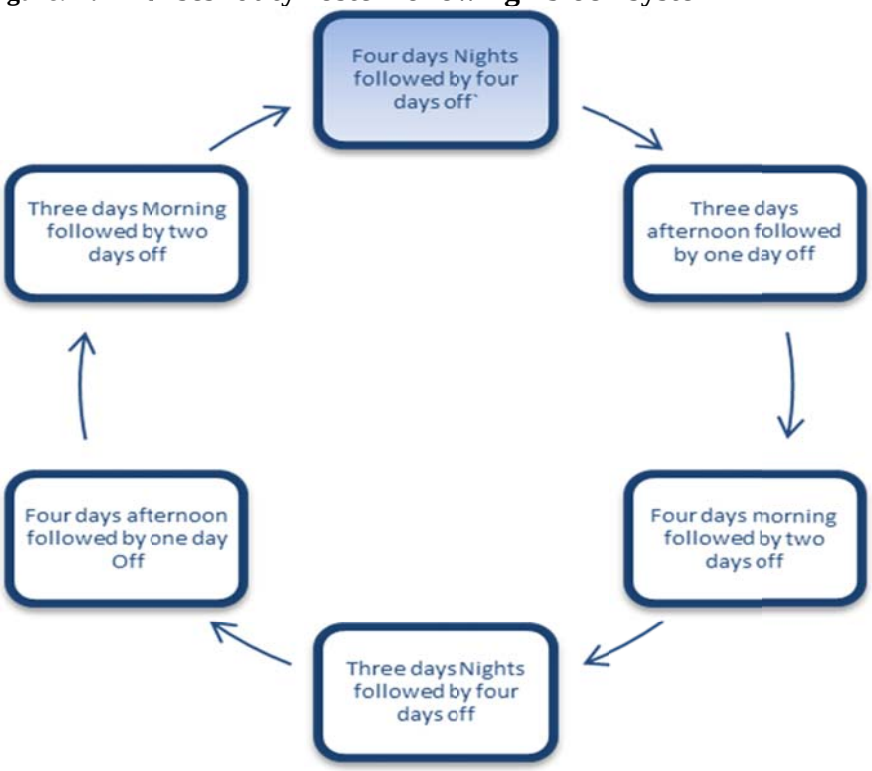
- Nurses' work schedule.
- Nurse-patient assignment.
- Activities prior to handoff report.
- Handoff process and practice.
- Information communicated during nursing handoff.
- Suggested changes in the handoff process and practice.

Nurses' work schedule

At the Royal Hospital, the nurses work three shifts a day: morning shift (7:30 a.m. to 2:30 p.m.), afternoon shift (2 p.m. to 9:00 p.m.), and night shift (8:30 p.m. to 8:00

a.m.). A 30-minute interlapse time between shifts is allocated for handoff reports. The nurses working at the Royal Hospital follow a "block system" duty roster, where a team of nurses stays in the same rotation for two to three months. As described by a charge nurse (RN14) "the use of block system enables the in-charge nurses equitably allocate the nurses based on their areas of interests and their level of experiences." Figure 4.2 depicts the "block system" as summarized by a charge nurse. The nurses start their rotation by doing four days night followed by four days off. The schedule then allots for three days afternoon followed by one day off, and then four days morning followed by two days off. The nurses later work three days night duty followed by four days off; followed by four days afternoon with one day off, and then they complete the block system by doing three days morning duty followed by two days off.

Figure: 4.2 Nurses' duty roster following "block system"



Nurse-Patient Assignment

During the first day of duty, e.g. after night-off, the nurses at the medical, surgical, and nephrology wards do not know their patient's assignment until after handoff. Thus, they have to attentively listen to the handoff reports of all the patients admitted in the ward, as rationalized by a charge nurse:

> This way, all team members are expected to know about all the patients admitted in the ward… and in case any of the nurses gets sick or has to leave the ward for any reason, the other nurses can easily take over the patients' care responsibility (RN5).

After the handoff report, the in-charge of incoming shift assigns the nurses to take care of up to six patients admitted in a cubicle, and employ the "staff assignment book" to write the nurses' assignments. However, for the subsequent days, the nurses remain in the same cubicle assignment, which enables them during handoff report to focus more on their assigned patients, ask questions, clarify any missing information, and ensure the continuity of care.

Activities prior to handoff report

The researcher observed the incoming nurses arrived at the unit 20-30 minutes before the start of their shift. During this time, they checked the equipment inventory as well as the "dangerous drug account" inventory. Once nurses finished the inventory, they read the "in-charge communication book" that is used to communicate important messages between shifts, such as any expected admissions or any medications that need to be ordered or collected from the pharmacy, etc.

Handoff process and practice

During the handoff, all nurses of the incoming shift met in a private room, such as the office of the ward in-charge or the seminar room, where they had to listen to the

handoff report of all the patients admitted in the unit. This finding was also supported by a majority of the survey respondents (84.7 %, N =133) who indicated the handoff report takes place in a private room, such as a staff or conference room. On the other hand, 8.3 % (N =13) of the survey respondents selected the handoff report takes place at the bedside, 3.8 % (N =6) selected it takes place in an open area, and 3.2 % (5) selected it takes place in both bedside and a private room. Contrary, findings of the twenty-handoff observations indicated none of the handoff report took place at the bedside.

At the beginning of the handoff report, the outgoing shift in-charge started by giving a brief report about the total patients admitted in the ward, the number of new admissions they received, the number of transfer-out, and any other messages that needed to be communicated to the upcoming shift. The researcher noticed that all the outgoing nurses took turns in giving the shift report for their assigned patients, with the exception of when the assigned nurse was busy with the patient's care or when the unit was less busy (10 or less patients) in this case, the shift in-charge of the previous shift gave the handoff report. Upon the completion of the handoff, the researcher noticed the incoming nurses normally went to the bedside to see their assigned patients and survey the bedside environment. Findings of the interviews and handoff observations revealed that the incoming nurses had a list of things to do at the bedside upon the start of their shift, which include:

- Greeting their patients.
- Checking the safety of the bedside environments.
- Ensuring the call bells are working and within patients' reach.
- Ensuring the intravenous lines are in place.

- Ensuring the patency of the drains and catheters.
- Assessing the patient's condition.

Once the incoming nurses surveyed the bedside environment, they logged into the Al-Shifa and wrote their receiving notes in the nursing Kardex, a module within Al-Shifa that is primarily used for nursing documentation, which summarized the information received during the handoff report as well as the findings of their assessment.

Information communicated during nursing handoff

Findings relevant to this section were drawn from the semi-structured interviews, observation of nursing handoffs, and artifact analysis. Data extracted from the interviews, and observations revealed there was no written policy that structured the information to be included in the handoff reports. This conclusion was also supported by 71.3 % (N =112) of the survey respondents believing there were no specific guidelines or policies that determined what information should be included in the handoff report.

During data analysis, the contents of nursing handoff were clustered around four themes: Situation, Background, Assessment, and Recommendation (SBAR) handoff communication format. Surprisingly, none of the units included in this study was found to use the SBAR handoff communication format.

As depicted in table 4.8, Situation (S) involves when the nurses started the handoff report by presenting basic demographic information about the patient that include: bed number, patient's first name, patient's age, diagnosis, and name of the treating team doctor. Background (B) requires the nurses to provide background information regarding the patient's main complaint, past medical and surgical histories, the reason for admission, etc. Assessment (A) comprises the process whereby the

outgoing nurses review the findings of the physical examination and the diagnostic test that were carried out, pending procedures that the upcoming shifts need to accomplish, etc. Lastly, recommendation (R) describes the nurses during handoff report as they gave overviews about the therapeutic and diagnostic recommendations that the treating doctor have included in the treatment plans of each patient.

Table: 4.8 summary of information communicated during handoff using SBAR.

Situation:	
• Bed number • Patient's first name • Age	• Diagnosis • Treating team doctor
Background:	
• The Date, time, and reason for admission • Any allergies the patient has • Current patient's condition • History of fall • Level of consciousness • Past Medical & surgical History • Require Isolation Precautions for …. • Requires I&O recording • Do Not Resuscitate order (DNR) • Expat patient (Paying OR with a free stamp) • Current treatment plan • Intravenous fluids on flow • On O2 therapy via … mask, rate, SPO2 …etc. •	• Mobility status (Ambulatory, needs assistant, Bed bound …etc. • Pre-operative care i.e., name of surgery, date & time, pre-operative preparation done or not, Reviewed by Anesthetist, Consent taken or not …etc. • Post-Operative Care i.e., name of surgery, when was it done, post-op complications…etc. • Skin condition i.e., Wounds, Pressure ulcer …etc. • Type of Diet i.e., Normal, Low Salt, Diabetes diet, NPO, NGT…etc. • For Hemodialysis via Perm Catheter or AV Fistula • Patient is currently in Operation Theater, Dialysis unit; CT scan room ….etc. The patient was sent at …. • Urinary catheterization i.e., Foley's, Silicone, Supra pubic ….etc.

Assessment:	
• Chief complaint • Recent fall score • Total intake and output • Diagnostic tests & their reports e.g.: • ECG • Radiology report • Ultrasonography • Echocardiography • Angiography • 24-hour halter monitor • Abnormal laboratory results • Sickling test	• Pain assessment i.e., intensity, character, location, score, measures taken to alleviate the pain …etc. • Skin condition i.e., any wounds, signs of pressure ulcer • IV Cannula i.e., location, duration, patency, pain, redness…etc. • Presence of thrill & bruit at Arteriovenous fistula • Latest SPO2 reading • Latest blood Sugar reading • Abnormal vital signs
Recommendation:	

• Pending work/procedures, such as:
  • Blood work for ….
  • CT scan …
  • X-ray …
  • MRI …
  • ECG
  • Pre-operative preparation
  • Bladder irrigation
  • Bladder training
  • Anesthetist review
  • Consent to be taken
  • Wound Dressing
	• Changes in the treatment plan, such as:
	  • Seen by Dr. X during round who advise to get second opinion of …
	  • Seen by surgeon who scheduled patient for surgery … on …
	  • Seen by Dr. X during round who started the patient on …
	  • Seen by Dr. X during round who discontinued …
	  • Patient for discharge on …

The analysis of the information shared surrounding nursing handoff revealed that the information communicated during handoff could be further stratified into two main categories: “Unit Routines” and “Patient care-related information.”

Unit routines included information about organizing unit’s logistics such as: the total patients admitted in the unit, any expected admissions or any expected patient’s transfers, recent trends in health care delivery that need to be circulated to all the nurses working at the unit, any incident happened at the unit, and any out-of-stock items that need to be ordered, including medications and ward supplies.

Patient care-related information that the nurses communicated during handoff could be further stratified into three subcategories; "basic demographic information," "key information," and "secondary information." The *basic demographic information* the nurses would like to know about their patients included: the bed number, patient name, age, and whether the patient is allergic to anything. The incoming nurses would like to know the following *key information* about their patients: the patient's diagnosis, level of consciousness, mobility status, falls history, the current condition of the patient, history of the present illness, past medical and surgical history, any abnormal labs or abnormal vital signs, the treatments the patient underwent, and the future treatment plan.

The *secondary information* included situation-based information that the incoming nurses normally needed to know about their patients. Examples of secondary information the nurses would like to know during handoff include:

- If any medications were not administered during the previous shift, the incoming nurses wanted to know the reasons for withholding these medications.
- If the patient has a urinary catheter, PermCath or any other catheters, incoming nurses wanted to know the type and the location of the catheter, and the catheter care given to the patient.
- Any pending procedures or results that the upcoming shift need to accomplish or follow up.
- Whether any of the patients have an infectious disease that require isolation precautions, incoming nurses wanted to know the type of isolation precautions need to be followed.

- If the patient is on intravenous fluids or blood transfusion on flow, the nurses wanted to know the name, the flow rate, the duration, and the location of intravenous cannula.
- If the patient is posted for surgery, the incoming nurses wanted to recognize the name of the surgery as well as the date and time of surgery. In addition, the incoming nurses would like to know whether the patient was seen by the anesthetist or not, if the sickling test was done or not, results of the latest hemoglobin and coagulation report, if consent for surgery given or not, and whether the preoperative preparations were done or not. If a patient may need blood or blood product during surgery, then the incoming nurses needed to know whether any blood was reserved.
- If the patient underwent surgery, the nurses wanted to know the name and the location of the operation, post-operative orders, number of postoperative days, wound condition, type of wound dressing of the patient, and any complications the patient developed postoperatively. If the patient has wound drainage, such as Redivac or J-vac wound drain, then the incoming nurses wanted to know the amount of fluid drained.
- If the patient is on oxygen therapy, the nurses wanted to know the recent oxygen saturation, type of mask, and percentage of oxygen on flow.
- If the patient complains of any pain, the incoming nurses wanted to know the acuity and the intensity of pain, pain score, painkillers administered, and the outcomes of these measures.

- If the patient was on dialysis therapy, the nurses wanted to know the last time the patient had dialysis, access the patient had for dialysis (i.e., PermCath or Arteriovenous fistula), latest electrolytes, such as Potassium, Urea and Creatine levels, and the intake and output during the shift. If the patient had AV fistula, then the incoming nurses needed to know the status of the fistula, if the thrill was heard, and whether the radial pulls was present.
- If the patient was a diabetic, then the incoming nurses wanted to know recent blood sugar levels and the treatment plan including medication and diet.
- If the patient was a bedridden, the nurses would like to know when the last positioning was done, whether the patient is incontinent, whether the patient has any pressure ulcers, the stage of pressure ulcer, and the pressure ulcer care.
- If the patient has nasogastric feeding, incoming nurses would like to know when the last feeding was given and how much was administered.

Suggested changes in the handoff process and practice

During handoff, as discussed earlier, all the nurses of the incoming shift met in a private room and listened to the handoff report of all the patients admitted in the unit. When asked for suggested changes in the handoff process and practice, the majority of the nurses who participated in Phase II of the study (N = 11, 78.6%) felt the current handoff process and practice is acceptable, while three of the nurses suggested having handoff done on a one-to-one basis at the bedside (RN4, RN5, & RN14).

When asked to list the advantages of conducting handoff reports at the bedside on a one-to-one basis, the nurses stated it would:

- Help the nurses manage the handover time effectively rather than gathering all the staff in one room and have them listen to the endorsement of all the patients admitted in the ward (RN14).
- Enable the nurse to know the patient ahead of time during the shift (RN4, RN5, & RN14).
- Give the incoming nurse a holistic picture about the patient and the surrounding environment (RN4, RN5, & RN14).
- Allow the incoming nurse to ask questions and clarify any missing information (RN4, RN5, & RN14).
- Help the nurse obtain accurate information about the patient condition (RN4 & RN5)
- Involve the patient in the decision-making (RN5).

Additionally, when the researcher further inquired about the barriers that hinder the implementation of one-to-one handoff at the bedside, the three nurses foresaw some barriers that may hinder the implementation of one-to-one handoff at the bedside. For example, when doing handoff on a one-to-one basis at the bedside:

- May breach the patient's privacy and confidentiality due to the fact that six patients are admitted in each cubical (RN14).
- The patient may interrupt the endorsement by asking questions or asking the nurse to do some other procedures (RN14).

Research Question 3 (RQ3)

This part of the study presents the findings of the qualitative phase relevant to RQ3, which aimed to identify the digital and non-digital artifacts that the nurses use to convey information between shifts and maintain distributed cognition among the health team members during handoff, and how these artifacts are integrated into the handoff reports.

During the interviews, the researcher asked participants about the tools "artifacts" that they use to exchange information between shifts; and how these artifacts get integrated into the handoff reports. The findings relevant to RQ3 are obtained from semi-structured interviews, handoff observations, and artifact analysis. During the analysis phase, these artifacts were classified into two broad categories:

a) Non-digital artifacts

b) Digital artifacts

a) Non-digital artifacts

The nurses listed a variety of non-digital artifacts that help the team members maintain situation awareness in the distributed cognition of nursing handoff. The non-digital artifacts are discussed in the following sequences;

- Staff assignment diary
- In-charge communication book
- Staff communication book
- Bulletin board
- Whiteboard
- Rounds' book

- Piece of paper
- Bedside nursing care plan

Staff Assignment Diary

All the four units included in Phase II of this study used a diary, called the "Staff assignment diary", which served as a non-digital artifact that the nurses use to communicate and coordinate nurse-patient assignments (see Appendix J). In a typical shift at the Medical-Surgical and Nephrology units, a nurse assumes the total care for up-to six patients admitted in a cubicle. Normally, the in-charge of the incoming shift or the unit in-charge plans the nurse-patient allocation based on the severity of the patient's condition and the nurses' level of experience. When asked about the importance of the "staff assignment diary" for nurses during handoff, all the nurses expressed it serves as a means to track the nurse-patient assignments and helps ensure the continuity of a patient's care. The nurses reported knowing their patients' assignment before the handoff report, "Enabled them to concentrate more on the handoff report of their assigned patients (RN2 to RN5)", and "permitted them to ask questions or clarify any missing information during the handoff reports (RN10 to RN13)."

In-charge Communication Book

All four units included in Phase II of this study used a book called the "in-charge communication book" (see Appendix K). The nurses used this diary to communicate important messages between the unit in-charge and the in-charges nurses of all shifts. When asked about the importance of this book for nurses during handoff, ten of the nurses stated this book helps in reminding the nurses of the subsequent shifts to perform specific procedures for a specific patient, e.g., "Book CT abdomen for bed number 30

(RN9).” This book served as a means for communicating “clerical jobs” across all the shifts, as described by a charge nurse:

> Since we don’t have unit coordinator, the in-charge communication book servers as a mean for communicating important messages between shifts such as; medication to be ordered, any expected admissions or transfer-in patient from other hospitals, or any pending procedures that I need to remind the staff to carry-out during the shift for a specific patient (RN1).

For instance, the shift in-charge used this book to write: the total patients admitted in the ward, any expected admissions or transfer-in patients, new trends in health care delivery that need to be circulated to all the nurses working at the unit, any incidents that happened at the ward, and any out-of-stock items to be ordered including medications and ward supplies.

Staff Communication Book

Three of the four units included in Phase II of this study used a “staff communication book” (see Appendix L), which were employed by the unit in-charge to communicate important messages concerning the nursing practice or to disseminate new circulars received from the nursing administration to all the nurses working at the unit across all shifts. The nurses working at the unit have to read the memo and put their initials indicating that they have read the memo. An example of these memos was quoted from one of the units:

> Documentation is very important and it has been noticed that no one is doing nursing process for their patient. Thus, all nurses are requested to ensure their documentation sheets are complete (Unit 4).

Another example was quoted at a different unit:

> From today on ward, during morning endorsement, night shift to morning shift, please make sure to report the total intake and output, and mention the fluid balance if negative or positive for the patient (Unit 3).

Bulletin board

All the four units included in Phase II of this study had a "bulletin board" (see Appendix M), which is located in the center of the unit just behind the nurses' station. The bulletin board served as a dynamic non-digital artifact that promoted the distributed cognition among the nurses, the medical team members, and the paramedical team members across all shifts. The nurses used the bulletin board to communicate important information across shifts, such as the names and the pagers of the on-call doctors, and the patient's directory. The patient directory is organized chronologically by bed number and has limited information about the patients admitted in each unit that can be shared with the public. More importantly, the bulletin board helps maintain the staff's situation awareness. For instance, as described by a nurses "By just looking at the patient directory you can tell at a glance the total patients admitted in the ward, occupied and vacant beds, patient's name, bed number, and their treating doctors (RN9)." The patient directory provides quick-reference to health care professionals about the patients admitted in the ward. In addition, the researcher noticed that the patient directory helps the nurses answer the relatives' questions and direct the visitors during the visiting hours.

Whiteboard

All the four units included in Phase II of this study had a "whiteboard" (see Appendix N), which is located in the center of the unit, across the nurses' station. The whiteboard was initiated by the in-charge of the night shift, and then was updated by the nurses of all shifts. It serves as a non-digital artifact that promotes situation awareness among the nurses and the rest of the medical and the paramedical professionals. The whiteboard summarizes the total number of patient admitted in the unit, the total new

admissions received during the day, the total emergency and elective surgeries that are posted for the day, the number of patients that require high dependency beds, and the names and pagers of the on-call doctors. In addition, the whiteboard acts as a means to communicate and coordinate patients' care among the health care professionals. For instance, the whiteboard is used to write the bed number of the patients who have pending procedures such as electrocardiogram, echocardiogram, physical therapy, dialysis, lithotripsy, angioplasty, CT scan, X-ray, and the patients that are planned to be discharged today.

Rounds' Book

Two of the four units included in Phase II of the study use a "rounds' book" (see Appendix O), which served as a non-digital artifact that the nurses used to communicate and coordinate patient care among the doctors during the rounds. The patients are sorted in the rounds' book chronologically by bed number. Beside each bed number, there are six columns: patient's sticker, patient's age, number of days hospitalized, name of the team doctor, patient's diagnosis, and rounds' remarks. During the morning shift, a nurse normally attends the doctors' rounds at the medical and urology ward. As the doctors discussed the treatment plan for each patient, the nurse used the remarks section to write recent changes in the treatment plan for each patient e.g. "for echo", "MRI spine", "AFB (-ve)." The researcher noticed the rounds' book was only integrated into the handoff report at the medical ward, where the in-charge of the incoming shift used the rounds' book to update and verify the information received during the handoff report.

Piece of paper

The researcher observed twenty nursing handoffs across all the shifts and noticed all the incoming nurses (N=97) used a letter-size paper - that was folded in half - to summarize the information received from the previous shift (see Appendix P for an example). This piece of paper served as to-do list, which reminded the nurses about the things they needed to accomplish throughout the shift. The nurses used this paper to write key-information they received during the handoff report that included: bed number, patient's diagnosis, name of the treating doctor, reason/s for admission, chief complaint, past medical and surgical history, the presence of urinary catheter, site of cannula, intravenous fluids on flow, pending procedures needed to be performed or required follow up during the shift, procedures or surgeries the patient underwent, expected discharge date, and abnormal vitals or laboratory reports. In addition, the nurses used this paper to write isolation precautions that they needed to be aware of when dealing with the patient that require isolation precautions such as methicillin-resistant Staphylococcus aureus (MRSA) or any other communicable diseases (e.g. Tuberculosis). This paper enabled the nurses, at the point of care, to write important information they need to enter into the Al-Shifa, such as the values of vital signs, results of blood sugar tests, the total intake or output, etc. Moreover, during doctors' rounds, it was easier and quicker for the doctors to ask the nurse specific information, such as total intake and output, rather than looking for this information in Al-Shifa. Thus, this sheet of paper served as a quick-reference for the nurses to respond to the doctors' questions.

Bedside Nursing Care Plan

Bedside nursing care plan (NCP) is the only paper-based documentation that the nurses used at the four units included in Phase II of this study. NCP served as a non-digital artifact for nurses to use at the point of care. The nurses described the NCP as "a sheet of paper in which the morning nurse or the admitting nurse assesses the patient and then will write the care plan, which is then implemented in the subsequent shifts (RN14)." All the nurses felt that the NCP served as a quick-reference for nurses about the patient's condition as well as a framework for nurses to provide individualized patient care across the three shifts. Three of the nurses (RN6, RN12, & RN14) viewed the NCP to be an essential part of patient care that included essential information for nurses to prioritize patient care, as described by one of the nurses:

> … when I receive new admission, I will first assess the patient and then review the admission notes. …. Then, I will write the nursing care plan that include: how often we need to check the patient's vital signs, the patient's mobility status, whether the patient has any wounds or not and how often we have to do wound dressing. And if the patient has any urinary catheter or any peripheral lines, then we have to write the name of the catheter and how long it has been in place. … I will also do fall assessment and write the fall score…, the type of diet the patient is taking …Whether the patient has an intravenous cannula and how long has it been in place, … any investigations that we need to collect or send to the lab today, and other remarks, such as follow up for echo report. Besides that, we also use this folder to include other forms, such as pre-procedure checklist, consent form, anesthesia sheet, ER treatment record, ECG, discharge plan and discharge instruction paper (RN6).

b) Digital artifacts

The only digital artifact that the nurses used to maintain distributed cognition surrounding nursing handoff was the Al-Shifa. Findings relevant to the nurses' use of Al-Shifa surrounding nursing handoff is divided into three stages:

1) Use of Al-Shifa before handoff
2) Use of Al-Shifa during handoff
3) Use of Al-Shifa after handoff

1. Use of Al-Shifa before handoff:

The researcher spent an hour observing the nurses' activities before the handoff reports (N =20). Interestingly, the researcher noticed none of the incoming nurses were able to use the Al-Shifa before the handoff reports. However, the researcher noticed the outgoing nurses used Al-Shifa to accomplish several activities in preparation for the handoff report. When the outgoing nurses were asked to describe the usefulness of Al-Shifa before the handoff report, all the fourteen nurses stated the use of Al-Shifa enabled them to obtain updated information about the patient, which thereby promote the accuracy of information exchanged during the shift report. When asked to enlist the tasks that the outgoing nurses perform using Al-Shifa before handoff reports, the nurses stated using Al-Shifa to accomplish the following tasks:

- Reviewing the nursing Kardex of the previous shifts (RN1 to RN14)
- Checking the Doctor's Progress Notes for new orders or changes in the treatment plan (RN3, RN5, RN6, & RN9).
- Reviewing the laboratory module for newly released lab reports (RN2, RN3, RN5R, RN12, & N14).

- Ensuring the completeness of their documentation (RN3, RN6, & RN13)
- Updating their piece of paper with important messages that they need to pass to the upcoming shift (RN5, RN6, & RN10).

All the fourteen nurses further stated using Al-Shifa to write a paragraph in the nursing Kardex that summarizes the care given to the patient during the shift as well as any pending procedures or reports that are pending for the upcoming nurse to follow up.

2. Use of Al-Shifa during handoff:

The nurses used a variety of artifacts that helped in maintaining the distributed cognition among the nurses across shifts. All the fourteen nurses perceived the Al-Shifa to be the primary tool that they use to facilitate electronic documentation of patient care and to promote effective and accurate communication among the nurses during the transition of care. When asked to describe the use of the Al-Shifa during handoff, ten of the nurses indicated it increased the accessibility to patients' medical records, which in turn enabled them during handoff to:

- Read the patients' demographic information.
- Read the Nursing Kardex.
- View doctors' notes.
- Check lab investigations.
- Review the procedures carried out for the patient.
- Track pending procedures that to be done or medications that need to be administered in the subsequent shifts.

During handoff reports, the nurses mainly relied on the information documented in the nursing Kardex of Al-Shifa. The outgoing nurses took turns in giving the report of

their patients. In all the nursing handoffs that were observed, the nurses followed the chronological order the patients appeared in the inpatient list and this was in bed number order (see Appendix S). The incoming nurses started by reading patient's demographic information as it appeared in the patient chart summary (see Appendix W), which included the patient name, diagnosis, age, the treating doctor, present and past medical and surgical histories. Then the nurses presented detailed information about the patient as documented in the nursing Kardex, a module within Al-Shifa that is primarily used for nursing documentation. The nurses use the nursing Kardex to electronically document the care they provided to the patient such as the accomplished procedures, summary of radiology and laboratory reports, any pending procedures, or reports the subsequent shifts need to perform or followed up. During handoffs the nurses occasionally referred to other modules to obtain specific information and to supplement the information presented in the Kardex, such as vital signs, intake and output charts, pain assessment, diabetic charts, radiology, laboratory and medication modules.

The researcher noticed the nurses at the medical unit delivered the morning handoff reports differently. For instance, all the outgoing (night) nurses gave the handoff report by reading from a piece of paper, while the unit in-charge used the Al-Shifa to check the accuracy, the integrity, and the completion of the information documented in the electronic health records. Once the in-charge nurse discovered missing information, then she asked the assigned nurse to fill-in the missing information. A staff nurse working at the medical unit perceived this practice to be difficult, stating "When giving the handoff report without using Al-Shifa, …we have to rely on our memories as well as the key information we have written in their piece of paper (RN9)." Another nurse,

further stated "this duplicates our effort… we have to electronically chart the patient care as well as we have to summarize important information in pieces of paper that we use during the handoff report (RN10)."

Moreover, during the observed handoff reports (N =20), the researcher noticed none of the incoming nurses (N =97) viewed the information that the outgoing nurses read from Al-Shifa. When asked about the reason for not sharing the computer screen with the incoming nurses during handoff, one of the in-charge nurses stated:

> As the office of the in-charge nurse is small and the monitor is not large enough for all the incoming nurses to see…. The way the monitor is placed facing the wall, which help protecting the patient privacy of patient information that is documented in Al-Shifa (RN8).

3. *Use of Al-Shifa after handoff:*

The researcher spent an hour observing the nurses' activities following the handoff reports (N =20). The researcher noticed that once the incoming nurses (N =97) received the handoff report, they went to the bedside to great their patients and surveyed the bedside environments. When asked to describe the role of the Al-Shifa after the handoff report, the nurses used Al-Shifa to:

- Review the information written in the nursing Kardex.
- Validate the information communicated during handoff report,
- Check the Doctor's Progress Notes for recent changes,
- Check the labs module for new order or newly released reports,
- Check the medications modules for new prescriptions or changes in the therapeutic plan,
- Write a receiving note in the nursing Kardex of each patient.

The receiving note summarized the information received from the previous shift as well as served as a baseline assessment of the patient's condition at the beginning of the shift. These findings were consistent with the survey responses, where 80.3 % (N =126) of the survey respondents reported after handoff they log into Al-Shifa to verify the accuracy of the information received from the previous shift. When asked about the use of Al-Shifa throughout the shift, a nurse summarized their use of Al-Shifa in a typical shift, as follows:

> When we receive the handoff report, we have to first go to the bedside to check the patient and the bedside environment. Then we have to write a receiving note, which summarize the information we received and the finding of the bedside assessment … Then, throughout the shift, we have to use laptops and desktops located at the nurses' station to document in the nursing Kardex the care we offer for the patient during the shift and all other events taking place around the bedside. We also have to check the Doctor's Progress Notes several times in a shift, a place where the treating doctors prescribe new procedures or therapies. If there is any addition or modification in the treatment plan, then as a nurse I will have to carry out the doctors' orders as well as document the patients' care in the nursing Kardex in Al-Shifa (RN14).

Research Question 4 (RQ4)

This section of the research presents the findings of the qualitative aspect of the study relevant to RQ4, which aimed to identify the strengths and the weaknesses of the electronic health records in supporting quality handoff report. As such, the research questions is as follows:

RQ4. What are the strengths and the shortcomings of the electronic health records in supporting quality handoff report during nursing handoff?

The findings relevant to RQ4 are presented in the following sequences:

- Features in Al-Shifa that are helpful for nurses during handoff
- Suggested changes in the design of Al-Shifa to better meet the information needs of nurses during handoff.

Features in Al-Shifa that are helpful for nurses during handoff

All the interviewed nurses (N =14) perceived the Al-Shifa to be the primary artifact that the nurses use to facilitate information exchange, to promote effective and accurate communication among the nurses during the transition of care. The use of electronic health records during handoff was reported to increases the accessibility to patients' medical records which in turn enabled the nurses read the patients 'demographic information, the care provided to the patient, the summary of the radiology and laboratory reports, and any pending procedures or report that the subsequent shifts need to perform or follow up on. While giving the handoff report, the nurses mostly relied on the information documented in the nursing Kardex that of Al-Shifa, which enabled them to view the notes of the previous shifts by selecting the date from the dropdown menu at the top left-hand corner of the Kardex screen (see Appendix U). One of the nurses highlighted the importance of the nursing Kardex as follows:

> The Kardex is set by default to show today's Kardex entries; with older entries at the top and the newer entries at the bottom of the page…. You can also view old Kardex entries by clicking on a dropdown menu found at the top left-hand side corner… You can select the date that you want to view its Kardex entries (RN5).

Features in the design of Al-Shifa that the nurses perceived to be useful include the fact that the system highlighted the abnormal laboratory values in different colors (i.e., orange color for slightly abnormal; and red color for drastically abnormal lab values) (see Appendix V). The ability of the system to present the abnormal lab result using a preset color scheme enables the nurses to distinguish abnormal lab results and then follow up with the doctors for further management. During the artifact analysis, the researcher also noticed that the Al-Shifa system allowed the nurse to enter or modify an entry within an eight-hour window, which gave the nurses the flexibility to respond to the

patient's care needs as well as foster proper documentation of patient care. In addition, the system provides "system flags" corresponding to the allergies the patient has, as well as any hospital born infections such as MRSA, MDRO or MRAB. The system allows users to click on the alert to read detailed information about the flagged allergy.

Suggested changes in the design of Al-Shifa to better meet the nurses' information needs during handoff.

The analysis of the information obtained through the interviews, observation and artifact analysis revealed that the system is missing some features that may be helpful for nurses during handoff. The suggested changes in the design of Al-Shifa are discussed in the following sequences;

- Demographic information toolbar
- Nursing Kardex
- Intake and output chart
- Medication Administration Module
- Handoff Communication Module

Demographic information toolbar

The demographic toolbar appears at the top of each screen, providing users with basic information about the patient including the patient's full name, age, date of birth, and nationality (see Appendix T). The nurses found this toolbar to be essential, as it helps them associate the information presented in the screen with the correct patient and thus decreasing the cognitive load. However, the nurses stated the demographic information toolbar did not include information about the patient's bed number. It was apparent from the nurses' responses that the bed number was an important element during handoff because this helped the outgoing nurses associate the information with the bed number

when giving the handoff report and ultimately maintains situation awareness the nurses during handoff.

Nursing Kardex:

The way the nursing Kardex is programmed in Al-Shifa, the system allows the nurse to enter or modify an entry within an eight-hour window. This gives the nurse the flexibility to respond to the patient care need as well as foster documentation of patient care efficiently. However, nurses working the night shift reported this time window is too short, due to the fact that night shift is almost 12 hours. The illustrative examples are as follows:

> If we want to add more information to an entry that is already documented in Al-Shifa, the system does not allow us to modify the entry beyond the eight hours window… To overcome this time constrain, we have to start a new Kardex entry to elaborate on the information that we have already documented in the nursing Kardex…. This causes fragmentation to the information communicated in the nursing Kardex (RN6).

> At night shift, the duty is 12 hours and we cannot change the Kardex after 8 hours (RN6, RN8, & RN12)

> Valid time of entry should be extended beyond the 8 hours because sometimes we get busy with admission and OT cases, especial if you are assigned more than eight patients (RN13).

> I like to extend the time for entering Kardex, as we face trouble to in entering information or changing some information more than 8 hours (RN10).

When reading the nursing Kardex during handoff, the nurses reported encountering difficulties because they did not have hyperlinks from the Kardex to other modules, such as labs, medications, etc. As illustrated by one of the nurses:

> If a nurse is viewing a patient's Kardex and s/he would like to check if the results of diagnostic test is released or not. Then, s/he will have to close the Kardex and then open the lab module, and to come back to the Kardex, then s/he will have to close the lab module and open the Kardex again (RN7).

Intake and output chart:

For some patients it is essential to calculate the fluid intake and output (I&O) of the patient. Those patients require the nurses to chart all the fluids the patient takes over a period of 24-hour, starting from 7:00 a.m. and ending the next day at 6:00 a.m. In the current version of Al-Shifa (2.0), the system automatically imports the intravenous fluids the patient gets into the I&O chart, but when it comes to blood product or Total Parenteral Nutrition, the nurses have to manually enter them into the I&O chart. The way the intake & output chart is programmed in Al-Shifa, the system does not permit "backdate charting". If the nurses become busy at the end of the night shift it is possible they may miss an opportunity to chart an intake or an output before 6:00 a.m., then the system will show the entry in the next day's fluid-balance chart. In addition, the system does not allow the nurses to edit an entry that is made into the I&O chart. At times, this affects the nurse's ability to maintain accurate intake and output charting, as described by one nurses "This negatively affects the fluid balance chart, especially some nephrology patients who are on a strict intake and output charting (RN3)." When asked about the actions the nurses take to overcome this issue, a nurse stated:

> If we miss to enter an intake or an output beyond the 6:00 am, in this case we have to manually total the intake and output, and document the accurate fluid balance in the nursing Kardex and report it the next shift (RN3).

Medication Administration Module:

The current version of Al-Shifa (2.0) requires two nurses to log into the system during the medication administration as a step to confirm the five "rights" of medication administration: right patient, drug, dose, route, and time. The nurses perceive this process to be a time consuming, unnecessarily delaying the medication administration process.

When asked to elaborate more on the medication administration process, one nurse summarized the process as follows:

> During medication administration, one nurses has to log into Al-Shifa and place a check mark beside the medication to be administered and click on save. Then the witness nurse has to login into Al-Shifa to confirm the five "rights" of medication administration. We have to repeat this process for every medication that they have to administer for all the patients (RN2).

The other difficulties the nurses encounter when using the medication administration chart that some medications require the nurses to check the patient's vital signs, and others require the nurses to check the patient's blood sugar before administering the medication. Accordingly, the nurses have to use their clinical judgment to decide whether to administer the medication or to omit the dose. For instance, if a patient is getting antihypertensive medication, then the nurse has to check the patient's BP. If the patient's BP is low, the nurse must then omit the dose and document under the remark section the reason as to why the medication was not administered. However, the current version of Al-Shifa does not fit the nurses' workflow, as described by a nurse:

> If a nurse place a check-mark beside the medicine indicating that the medication is not administered and accidentally hit the save button before writing the remarks, then the nurse cannot come back to the system to add the reason for not administering the medication (RN6).

Moreover, when the nurses compared the previous version of Al-Shifa with the current version of Al-Shifa, many stated that the previous medication administration chart was "better" as it "did not require additional clicks." In the current version of Al-Shifa, the nurses during handoff could not distinguish between the medication that was given and the ones that were omitted. As described by one of the nurses:

> In the previous version of the medication chart, the omitted medication used to be displayed in red with a strike-through line, which visually informed the staff that the medication was not given… Using this version of Al-Shifa, during handoff we cannot tell if a medication was administered or not by just looking at the

> medication list… The nurses need to open the each medication see if it was administered or not, and we do not have time to open each medication during handoff (RN12).

Create Handoff Communication Module:

Findings of the interview and observations revealed that the nurses felt the opening and closing of modules during handoff disrupts their thoughts and unnecessarily delays the handoff process. They suggested having a "handoff communication module" that may help in structuring handoff communication. The illustrative remarks include:

> We would like to see all patient information in one module instead of closing the page and going back to check lab results or radiology or doctors notes (RN2).

> Having a handover module that has the patient demographic information at the top of the page, and having links to the recent labs, recent vitals, pending procedures, current medications, etc. would be a great thing (RN8).

> I look forward to having the handoff communication module which will import all-important information in one screen. This way, the overlap time between shifts could be utilized for communicating important information between shifts that will ultimately improve the quality and continuity of care… Would like to see new section in Al-Shifa that provide only summary of what nurses have done during 24 hours for the patient and patient condition at the end of the shift (RN9).

> Develop a section for handover which contains brief patient information, lab report, and x-ray report … we can customize what information needs to be pulled …It would be good that if this module/summary has any notification and it would be great if it is printable (RN5).

Table 4.9 represents the findings to survey questions corresponding to Q28-Q31 that were designed to elicit the nurses' feedback about the availability of the handoff communication module. Most of the survey participants (N =152, 96.8 %) reported that the Al-Shifa interface does not have a specific section/module designated for handoff communication. The participants were asked a follow up question geared toward identifying their needs for a specific Module within Al-Shifa designated for handoff communication. This yielded majority of the participants (N = 142, 90.4 %) reported they

would like to have a specific module within Al-Shifa designated for handoff communication, while the remaining (N =15, 9.6 %) reported they do not see a need for handoff communication module. Out of the 142 participants who reported a need for handoff communication module, a large majority (N = 136, 95.8 %) preferred to import patient's information directly from Al-Shifa into the handoff communication module. In contrast, very few (N = 6, 4.2 %) preferred to input the information manually into the handoff communication module.

Table: 4.9 Handoff communication module screening

Variables	Frequency	Percent
Q28. Do you have a specific section/Module within Al-Shifa designated specifically for handoff communication (N =157)		
Yes	5	3.2
No	152	96.8
Q30. Do you think it is necessary to have handoff communication module within Al-Shifa (N =157)		
Yes	142	90.4
No	15	9.6
Q31. How would you like to use this handoff communication module? (N =142)		
allow nurses to import patient's information directly from Al-Shifa	136	95.8
allow nurses to manually enter patient information	6	4.2

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter summarizes the findings of the present study that aimed to assess nurses' satisfaction with an electronic health record in structuring handoff communication. This study also explored handoff practices in Oman, identified information nurses communicated during handoff, ascertained the artifacts that the nurses used to construct situation awareness about the patients' condition, and elucidated the activities surrounding nursing handoff. The present study is an exploratory study that employs a mixed-method, quantitative and qualitative, approach to address the following research questions:

RQ1. How satisfied are nurses with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff?

RQ2. What is the content and the context of nursing handoff in Oman?

RQ3. What digital and non-digital artifacts do nurses use to convey information between shifts and maintain distributed cognition among the health team members during handoff, and how are these artifacts integrated into the handoff reports?

RQ4. What are the strengths and the shortcomings of the electronic health records in supporting quality handoff report during nursing handoff?

Findings of this study demonstrated that the nurses had positive perceptions about the perceived usefulness and the ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care

during handoff. All the nurses of the incoming shift met in a private room and listened to the handoff reports of all the patients admitted in the unit. The SBAR handoff communication format was used to guide the researcher identify, organize and cluster the information communicated during nursing handoff. None of the units included in this study was found to use the SBAR handoff communication format.

Additionally, to ensure continuity of care and the delivery of quality handoff reports, findings of this study revealed that the nurses used variety of artifacts that helped documenting, communicating and coordinating patients' care across the transition of care. During handoff observations (N = 20), the researcher noticed that the nurses relied heavily on the information documented in the electronic health records, Al-Shifa. The use of electronic health records was reported to increase the accessibility to patients' medical records, and promote accurate information exchange during handoff that are essential for ensuring the quality and the continuity of care across the different shifts.

5.2 Nurses' satisfaction with the usefulness and ease of use of electronic health record (RQ1)

Technology Acceptance Model (TAM; Davis, 1986, 1989) was adapted to assess the nurses' satisfaction about the usefulness and ease of use of the electronic health records, Al-Shifa, during handoff. The TAM model is an established tool that has been tested and proven to be reliable and robust in predicting user acceptance of technologies, attaining Cronbach's alpha reliability estimate of .97 for perceived usefulness and .86 for ease of use (Davis, 1989).

A Spearman's Rank Order correlation was run to determine the relationship between perceived usefulness and the perceived ease of use of the electronic health

records with the likelihood of using them during handoff. A statistically significant positive correlations were reported between perceived usefulness of electronic health records and the likelihood of using them during handoff (r= .38, P = .000). Similarly, the perceived ease of use of electronic health records and the likelihood of using them during handoff showed a statistically significant correlations (r= .39, P = .000). Thus, the findings of the technology acceptance model indicated that the nurses had positive perceptions about the usefulness and ease of use of the electronic health records during handoff. The nurses' acceptance of the electronic health records as easy to use contributes to their usage during handoff and to their perceived usefulness of Al-Shifa. These findings indicate as the perceived usefulness of the electronic health records increases, the likelihood of using them during handoff increases. This conclusion is consistent with the finding of Sachidanandam (2006), who reported the perceived usefulness of the clinical information system to be an important predictor of the physicians' use of the system, when compared to the system ease of use.

Moreover, the use of the electronic health records during handoff was found to increase the accessibility to patients' medical records, which in turn enabled the nurses to present updated information about the patient, which thereby promote the accuracy of information exchanged during the shift report. This finding is consistent with the results observed in a previous study by Chismar & Wiley-Patton (2003). They found the physicians were willing to adopt and use internet-based health applications, if they perceived applications to be useful in increasing their productivity, and improving their quality of care.

Most of the nurses participated in this study (80.3 %, N = 126) studied how to give handoff reports in their nursing programs, and 56.7 % (N = 89) of the nurses received formal in-service training on what to include in a nursing handoff. Both of these may have positively contributed to the nurses' satisfaction about the perceived quality of the handoff report they receive. These findings coincide with the recommended strategies by Ardoin & Broussard (2011), who suggested the new staff orientation programs should include information about the hospital's policy and procedure on handoff communication. Thus, conducting such training would greatly contribute to delivering consistent and accurate information during handoff.

Nonparametric Spearman's rank correlations were done to test for significant statistical difference among the participant's demographics. It is important to note that the nurses' age had a statistically significant positive correlation with nurses' level of experiences (r = 0.819, P =.000) and years of using Al-Shifa (r = 0.358, P =.000). On the other hand, the nurses' age had a statistically significant negative correlation with the perceived ease of use of Al-Shifa during handoff (r = - 0.164, P =.040) and the nurses' computer skills (r = -.301, P =.000). Thus, in order to increase older nurses' acceptance of the electronic health records, it is important to provide computer-training sessions. Similarly, the nurses' level of experience had a statistically significant negative correlation with the nurses computer skills (r = -0.263, P =.001).

5.3 Information communicated during handoff (RQ2)

Interestingly, finding of this study revealed that the nurses in Oman use the term "endorsement" to describe the handoff report that takes place between shifts. To the

researcher knowledge, the term "endorsement" was only used once in the medical literature in the context of shift report (Freitag & Carroll, 2011).

The nurses in this study delivered the handoff report on one-to-group basis. In addition, the nurses follow "block system" duty roster, where a team of nurses stays in the same rotation for two to three months. In the distributed cognition of nursing handoff, the use of block system duty roster was found to be very useful in the sense that all members of the incoming shift presumably have the same background information about the patients admitted in the unit. Therefore, this enables all members of the incoming shift to construct situation awareness fairly at the same level. Situation awareness is an important aspect of teamwork in the clinical setting that helps the team members create a joint understanding of the patient's current condition and the tasks the incoming nurses need to accomplish in the subsequent shifts (Groff & Augello, 2003).

The content and the duration of the handoff report varied across shifts and units. The length of the handoff report ranged from 17 to 90 minutes per shift, with an average of 2.07 minutes per patient. This variation is attributed to number of factors that include the absence of written policy or guidelines that standardize the information communicated during the handoff reports, the total patients admitted in the unit, the severity of patient condition, and whether the nurses took care of the patient recently or not. The absence of handoff policy contributed to variation in the information communicated during handoff. These results coincide with studies by Olson (2008) and Welsh, Flanagan, & Ebright (2010) who found that lack of standardization of handoff communication resulted in disorganized handoff reports, lengthy handoffs, and inaccuracy of information communicated. Moreover, it was observed when the patient's

condition is very severe or when the incoming nurses assume the patient's care responsibility for the first time, the outgoing nurse (sender of information) spent longer time reviewing the present and past medical histories, the reason for admission, the treatments the patient underwent, and pending procedures that the upcoming nurses have to accomplish. Thus, for the incoming nurses (receiver of information) to construct situation awareness about the patient's condition, they need to listen to the verbal handoff report, take note of key information communicated during handoff, ask questions and clarify any missing information that are essential to ensure the continuity of care.

Furthermore, the analysis from the current study suggests that the information communicated surrounding nursing handoff could to be stratified into two main categories: "*Unit Routines*" and "*Patient care-related information*."

Unit routines included logistics that are necessary to coordinate work at the nursing unit that include information such as staffing concerns, bedding, supplies, maintenance, and messages that need to be communicated to all nurses working at the unit. As in previous studies, the data suggests an essential aspect on handoff communication is centered toward exchange of relevant and up-to-date patient care-related information that are essential to ensure the continuity of care. Moreover, the results of the study support the use of the Situation, Background, Assessment, and Recommendation (SBAR) handoff communication format to structure and standardize handoff communication among nurses, as reported in former studies of nursing handoff (Haig, et al., 2006; Raines & Mull, 2007; Velji, et al., 2008). The mnemonic SBAR encompasses all the aspects of the patient care-related information that are necessary to

ensure the continuity and the quality of patient care. Surprisingly, none of the nurses participated in this study had used SBAR in the past.

In the context of handoff communication, Situation refers to the basic demographic information that the incoming nurses would like to know about their patients including; bed number, patient's first name, patient's age, diagnosis, and name of the treating team doctor. Demographic information is essential for nurses to articulate the information delivered during the handoff report with the right patient. The study findings also suggested that the nurses would like to know background information relevant to the illness that the patient's suffer from including the chief complaint, present and past medical and surgical histories, and the reason for admission. Knowing the background information about the patient's illness enables the nurses to evaluate the patient's condition and the response to the therapies. The study found that the nurses during handoff needed to know the results of the recent assessments and the diagnostic tests that were done for the patient or pending tests that the nurses of the upcoming shifts need to accomplish. Recommendation is the final aspect of the SBAR handoffs communication, where the nurses needed to know the recommended therapies and the diagnostic tests that the treating doctors have included in the treatment plans of each patient. Quotes from the nurses note that knowledge of the recommended therapies enabled the nurses to execute the doctors' orders, to perform the requested diagnostic test, as well as to follow up the results with the concerned doctor.

5.4 Artifacts used to maintain distributed cognition during handoff (RQ3)

Another goal of this research was to examine the artifacts that the nurses employed to maintain distributed cognition and situation awareness during the handoff

within the medical and paramedical communities across shifts. According to the theory of distributed cognition, it is important to note that team members have different knowledge and different information resources that contribute in constructing situation awareness, a state of knowing what is going on (Endsley, 1995), or a state in which the individuals comprehend the situation in order to make an appropriate decision (Artman & Garbis, 1998).

Hospital settings require high degree of work coordination and information sharing in order to provide an inter-disciplinary patient care (Symon, Long, & Ellis, 1996). Thus, findings of the current study revealed that nurses used variety of artifacts to coordinate patient care, to convey information between shifts, and to maintain distributed cognition among the health team members during handoff. These artifacts were classified into two broad categories: digital artifacts and non-digital artifacts. While the health policy in Oman mandates the implementation of paperless documentation systems, the researcher found that the nurses still use variety of non-digital artifacts to supplement the information communicated in the Al-Shifa across the transition of care.

Al-Shifa was the only digital artifact that the nurses used to facilitate electronic documentation of patient care and to promote effective and accurate communication among the nurses during the transition of care. The nurses' use of Al-Shifa surrounding nursing handoff was classified into three stages: before, during, and after handoff. None of the incoming nurses were found to use the Al-Shifa before handoff, while the outgoing nurses used Al-Shifa extensively. In preparation for the handoff report, the outgoing nurses used Al-Shifa to ensure the completeness and the preciseness of their documentation. Furthermore, the outgoing nurses spent the end of their shift writing a

paragraph in the nursing Kardex -- a module within Al-Shifa that is primarily used for nursing documentation -- of each patient that summarizes the care given to the patient during the shift as well as any pending procedures or reports required for the upcoming nurse to follow up on. During handoff, the nurses heavily relied on the information documented in the nursing Kardex of Al-Shifa. This finding is contrary to the findings of former study of nursing handoff by Staggers & Jennings (2009), who found none of the nurses accessed the electronic health records during nursing handoffs. This could be attributed to the enforcement of paperless documentation policy in Oman. In addition, the study revealed that the use of Al-Shifa during handoff played an important role in increasing the accessibility to patients' medical records, which in turn enabled the nurses to deliver accurate and up-to-date information about the patient. The use of Al-Shifa during handoff not only increased the accessibility to the patients' records, but also eliminated the reliance on the nurses' internal memories during handoff. The reliance on nurse's memories was formerly reported to be a leading factor to incomplete information or loss of information across the transition of care (Groff & Augello, 2003; Matic, et al., 2010; Olson, 2008).

As discussed earlier, the primary focus of this study was to explore the role of electronic health records in structuring handoff communication and maintaining situation awareness among nurses during handoff. However, the findings of the interviews and the field observations, revealed that the nurses use variety of non-digital artifacts to supplement the information documented in Al-Shifa as a means to maintain situation awareness throughout the nursing handoff. The non-digital artifacts were mostly used to

coordinate patients' care and collaborate with the multidisciplinary teams as a step to provide a holistic care and to ensure the continuity of care.

The most prominent non-digital artifact that the nurses used during handoff was a letter-size paper, known in literature "Cheat-Sheet" (Friesen, White, & Byers, 2009) (see Appendix P). The nurses used this sheet of paper to summarize the information received from the previous shift as well as served as to-do list, which reminded the nurses about the things they needed to accomplish during the shift, and in turn contributed to their situation awareness. Former studies of handoff found many nurses employed blank sheets of paper to make note of key information communicated during handoff (Friesen, et al., 2009; Hardey, Payne, & Coleman, 2000; Staggers & Jennings, 2009). This sheet of paper was found to be portable and handy for nurses to use at the point of care to take notes of important information that the nurses needed to document into the Electronic health records. On the contrary, Friesen, et al., (2009) reported the use of cheat-sheet threatens the continuity of care due to the fact that the information documented in this sheet is only accessible to the assigned nurses, and poses threat to the continuity of care, especially if the cheat sheet is lost or misplaced. Furthermore, Hardey, et al., (2000) reported the use of this sheet of paper pose threat to patient confidentiality, especially if the paper was lost or not properly discarded.

Additionally, the whiteboard and the bulletin board were another important non-digital artifact that the nurses relied on during handoff. The use of the whiteboard acted as a means to communicate and coordinate patients' care among the health care professionals and enabled the healthcare professionals to construct situation awareness about the pending procedures that the upcoming shifts need to accomplish. This finding

consistent with Xiao, et al., (2007), who found the use of the whiteboard in a trauma center to be "an integral part of cognitive functions, keeping staff informed of events, activities, and status." Bulletin board also was used to display important information that are essential to communicate and coordinate work among the multidisciplinary team across shifts. For instance, the names and the pagers of the on-call doctors, the total patients admitted in the ward, occupied and vacant beds, patient's name, bed number, and their treating doctors.

5. 4 Strengths and weaknesses of the electronic health records in supporting quality handoff report (RQ4)

The current study revealed that electronic health records, Al-Shifa, to be the most important artifact that the nurses use to communicate patients' information during handoff. When using electronic health records during handoff, it was found to increases the accessibility to patients' medical records that enabled the nurses to view the patient's entire medical records and to deliver accurate and up-to-date clinical information about the patient. An important finding of the present study suggests reading directly from the electronic health records during handoff minimizes the reliance on nurses' internal cognition, which was formerly reported to be a leading factor for incomplete information or loss of information across the transitions of care (2003; Matic, et al., 2010; Olson, 2008).

Despite the ubiquity of electronic health records, the research suggests that interface design could be enhanced to improve effectiveness and efficiency of the handoff. Results of the survey revealed that the majority of the survey respondents (N = 142, 90.4 %) suggested having a specific module within the Electronic health records

designated for handoff communication. This finding builds upon Staggers & Jennings (2009) and Welsh, Flanagan, & Ebright (2010) who found the electronic health records are not customized to fit the nurses informational needs in the context of nursing handoff. Creating such a module within the electronic health records, would enable the nurses to import up-to-date patient's information directly from the electronic health records into the handoff communication module as well as provide a structured format that standardize the content of the shift report. In addition, this module would enable the nurses to add personalized remarks for each patient that are necessary to provide culturally sensitive patient care. Ultimately, this would spare the shift overlap time for joint planning of patient care, significantly minimize informational gaps, and promote the effectiveness and efficiency of handoff practices, and subsequently improve the quality of handoff reports.

CHAPTER 6: CONCLUSION

6.1 Impact of the study

Given the fact that handoffs have been reported to be a worldwide issue in clinical care settings, it is important to study this issue, particularly in a developing country like Oman where electronic health records are becoming the vehicle for information communication and exchange among the multidisciplinary teams of healthcare professionals. Findings of this study add to the body of knowledge by filling the literature gap on the understanding of the role of electronic health records in structuring and standardizing handoff communication. In addition, findings of this dissertation study presents implications for health policy makers to develop a policy that identifies the information needs to be included in handoff reports, which in turn would standardize handoff communication, promote the consistency and the quality of information exchanged during handoff. Findings of this dissertation study also present implications for clinical information system developers to marry the aspect of the SBAR handoff communication tool with the electronic health records interface. This would enable the nurses to import up-to-date patient information into the handoff module, which in turn may contribute to standardizing the contents of handoff report.

6.2 Limitations

A mixed-method, quantitative and qualitative, approach was used to study the nurses' acceptance of the electronic health records in structuring handoff communication and explore the handoff practices in Oman and the artifacts that the nurses use to construct situation awareness about the patients' condition in order to ensure continuity of care and the delivery of quality handoff report. Findings of this case study are somewhat limited because of the exploratory nature of the study as well as the purposeful

sampling method employed. In spite of having a large number of nurses recruited from the same hospital, it could have been ideal to conduct the study in at least two or three hospitals that use Al-Shifa and examine nurses with different levels of experience. This will produce variability in the demographic characteristics of the participants as well as may fulfill the normality assumption needed to conduct parametric tests. In addition, this may increase the generalizability of the study findings. In addition, knowing that the researcher is observing the handoff process, this may have caused the participants to behave differently "Hawthorne effect", which could be another potential limitation of this study.

6.3 Future Research

Despite the limitations, the findings of this study have interesting implications and recommendations for future research. Given the fact that the SBAR has been reported to be the most popularly adapted handoff communication methods in the U.S. (Joint Commission Center for Transforming Healthcare, 2010; Veltman & Larison, 2007), to the researcher's knowledge, no electronic health records to date has integrated aspects of the SBAR tool into the electronic health records interface. This finding builds on Staggers & Jennings (2009) who recommended the clinical information systems should be "tailored" to meet the nurses' information needs in each unit.

Moreover, this study focused on the handoff that takes place between shifts. However, in clinical practice, another important handoff that takes place when the patient is moved from one unit to another within the same hospital. Thus, another potential study might consider exploring the role of electronic health records in structuring handoff report and ensuring the continuity of care during patient's transfer.

Furthermore, all the handoffs observed in this study, involving 382 patients, took place away from the bedside. However, the current trend in western countries that handoff should be done at the bedside, involving the patient or family members (Laws & Amato, 2010; McMurray, et al., 2010; Nelson & Massey, 2010). Thus, future research needs to further examine the use of electronic health records at the point of care and the extent of patient involvement during handoff and its impact on the accuracy of the information exchanged during handoff and the overall quality of the handoff reports.

Given the fact that the nurses' age showed statistically significant negative correlation with the perceived ease of use of Al-Shifa during handoff ($r = - 0.164$, $P = .040$), it would be wise to gain an understanding of their interaction with Al-Shifa. Thus, future researcher may consider studying the older nurses' satisfaction with the Al-Shifa use during handoffs.

Lastly, the fact that 100 % (N =157) of the survey respondents indicated using a piece of paper to write the key information they received during the handoff. Additionally, the researcher observed 97 incoming nurses and found all nurses used a piece of paper to record important information about the patient as well as served as to do-list for nurses during the shift. This creates another potential study that examines the possibility of creating a mobile application that serves the nurses' information needs throughout the shift, with particular emphasis on handoff report.

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Appendixes

Appendix A: Survey Questionnaire

Investigator's Name: Said Alghenaimi, RN-MSN, MS Ed Tech. Project # 1195463

CONSENT FORM

DEAR REGISTERED NURSE,

My name is Said Alghenaimi and I am Doctoral Candidate at the University of Missouri, USA. I am a certified registered nurse and I work for Oman Nursing Institute as Nursing Tutor. Right now, I am working on my doctoral dissertation research project. My research is geared toward studying the practice of nursing handoff in Oman, particularly interested to know the role of electronic health records, Al-Shifa, in supporting the nurses' information needs during change of shift (handoff/handover) and to ensure the continuity of care across shifts.

INTRODUCTION

This consent may contain words that you do not understand or is not clear to you, please ask the investigator to explain any words or information that you do not clearly understand. This is a research study that includes only people who choose to participate. As a study participant, you have the right to know about the procedures that will be used in this research study so that you can make the decision whether or not to participate. The information presented here is simply an effort to make you better informed so that you may give or withhold your consent to participate in this research study. You are being asked to take part in this study because you have specialized knowledge about patient's

handoff/handover that occurs among nurses between shifts. In order to participate in this study, it will be necessary to give your written consent.

WHY IS THIS STUDY BEING DONE?

The purpose of this study is to explore handoff practices in Oman, identify the tools the nurses use to construct a common understanding about the patients' condition, and assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff.

HOW MANY PEOPLE WILL TAKE PART IN THE STUDY?

About a minimum of 155 nurses will take part in this part of the study at the Royal Hospital in Oman.

WHAT IS INVOLVED IN THE STUDY?

During this part of the study, your consent will be needed to fill-in survey questionnaire.

HOW LONG WILL I BE IN THE STUDY?

Your participation will include completing a survey questionnaire that would approximately take thirty- minutes.

Note: You may sign-up for a follow up semi-structured interview and observation of shift handoff that would take around 45 minutes. If you enlist your name for the interview, the researcher will explain to you the second phase of the study and will present you with another consent form. You can stop participating in this study at any time. Your decision to withdraw from the study will not affect you in any way.

WHAT ARE THE RISKS OF THE STUDY?

The potential risks for participating in this study are minimal.

ARE THERE BENEFITS TO TAKING PART IN THE STUDY?

If you agree to take part in this study, there may or may not be direct benefit to. You may expect to benefit from taking part in this research to contribute to research trying to improve the practice of nursing handoff and may identify ways to improve the design of Al-Shifa to better serve the nurses' needs in the context of nursing handoff in Oman.

WILL I BE PAID FOR PARTICIPATING IN THE STUDY?

Upon the completion of the survey, your name will be enlisted in a raffle draw to win a Brand New Apple iPad 2nd generation 16GB with Wi-Fi which will take place at one of your continuing education seminars within a month of completion of the study. The name of the winner will be circulated to all the participating units.

WHAT OTHER OPTIONS ARE THERE?

If you wish to withdraw from the study, you are free to do so. If you decide to withdraw, please inform the investigator and your information will not be used in this study as well as your name will not be included in the raffle draw.

WHAT ABOUT CONFIDENTIALITY?

Information produced by this study will be coded and stored in a secured virtual private network at the Sinclair School of Nursing at the University of Missouri. The code key connecting your name to specific information about you will be kept in a separate, secure location. Information contained in your records may not be given to anyone unaffiliated with the study in a form that could identify you without your written consent, except as required by law.

It is possible that your medical and/or research record, including sensitive information and/or identifying information, may be inspected and/or copied by the study staff in the course of performing their duties. If your record is inspected or copied by the study staff at the University of Missouri and/or Ministry of Health in Oman will use reasonable efforts to protect your privacy and the confidentiality of your medical information. The results of this study may be published in a medical book or journal or used for teaching purposes. However, your name or other identifying information will not be used in any publication or teaching materials without your specific permission.

WHAT ARE MY RIGHTS AS A PARTICIPANT?

Participation in this study is voluntary and you do not have to participate in this study if you do not want to. Your present or future work will not be affected should you choose not to participate. If you decide to participate, you can change your mind and drop out of the study at any time without affecting your work at the *Royal Hospital.* Leaving the study will not result in any penalty or loss of work benefits. In addition, the investigator of this study may decide to end your participation in this study at any time after *he* has explained the reasons for doing so. You will be informed of any significant new findings discovered during the course of this study that might influence your health, welfare, or willingness to continue participation in this study.

WHOM DO I CALL IF I HAVE QUESTIONS OR PROBLEMS?

You may ask more questions about the study at any time. For questions about the study or a research-related injury, contact *Said Alghenaimi* at *+968 96001567*.If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study,

you may contact the University of Missouri Health Sciences Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-3181 or you can email irb@missouri.edu.

SIGNATURE

I confirm that the purpose of the research, the study procedures, the possible risks and discomforts as well as potential benefits that I may experience have been explained to me. To consent to take part in this research study, you must be a registered nurse working at any of the following eight units: Male Medical I, Male Medical II, Female Medical I, Female Medical II, Male Surgical, Female Surgical, Oncology, or Nephro-Urology units. I have read this consent form and my questions have been answered. My signature below indicates my willingness to participate in this study.

Participant Signature	**Date**

Instruction: Circle the choice indicating your response. You must answer all the questions.

Section I: Nurses Satisfaction with the use of Al-Shifa during handoff/endorsement

1. Using Al-Shifa enables me to give handoff report more quickly.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

2. Using Al-Shifa during handoff improves my job performance.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

3. Using Al-Shifa during handoff increase my work productivity.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

4. Using Al-Shifa enhance the effectiveness of handoff communication.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

5. Using Al-Shifa make it easier to give handoff report.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

6. I find Al-Shifa useful when giving handoff report.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

Perceived ease of use Al-Shifa during nursing handoff/endorsement

7. Learning to use Al-Shifa is easy for me.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

8. I find it easy to get Al-Shifa to do what I want it to do.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

9. My interaction with Al-Shifa is easy for me to understand.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

10. I find Al-Shifa to be flexible to interact with.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

11. It is easy for me to become skillful at using Al-Shifa.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

12. I find Al-Shifa easy to use.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

Section II: Process and practice of handoff

13. In your department, handoff report is mainly delivered:

Note: check all that apply

□ a. Verbally

□ b. Written on paper

□ c. Tape-recorded

□ d. Computerized using Al-Shifa

□ e. Others specify _____

14. In your department, who all are involved in the handoff report?

□ a. It is only me and one of the incoming shift nurses.

□ b. All the incoming shift nurses and me.

15. In your department, handoff report take place at:

□ a. A private room, such as staff room or conference room

□ b. An open area, such as nursing station

□ c. Bedside only

□d. Both bedside and private room

Quality Handoff Report

16. I spend the end of the shift time to copy important information from Al-Shifa in a piece of paper.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

17. When giving a handoff report, I rely on Al-Shifa to communicate important information that I need to pass to the next shift.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

18. During handoff report, I rely on a piece of paper instead of Al-Shifa to remind myself with the information in need to pass to the next shift.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

19. When giving handoff report, I depend on my memory to recall the information I need to pass to the next shift.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

20. Approximately, how much of your time is spent preparing for the shift report?

□ a. < 5minutes

□ b. 6 to 10 minutes

□ c. 11 to 15 minutes

□ d. 16 to 20 Minutes

□ e. >21 minutes

21. On average, the time it takes to complete handoff report is too long.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

22. After handoff report, I normally go back to Al-Shifa to verify the accuracy of the information I receive from the previous shift.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

23. The use of Al-Shifa during handoff promotes the continuity of care.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

24. When using Al-Shifa during handoff, it takes longer time to complete handoff report.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

25. The current handoff practices pose risk for losing or missing information during the transition of care.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

26. I am satisfied with the quality of handoff report that I receive.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

27. Using Al-Shifa during handoff enhances the accuracy of the information exchanged.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1	2	3	4	5

System Design

28. Do you have a specific Module/section within Al-Shifa designated specifically for handoff communication?

    □ a. Yes **If your answer yes, move to question 30**

    □ b. NO

29. If no, would you like to have a specific Module within Al-Shifa specifically designed for handoff communication?

    □ a. Yes □ b. NO

30. Do you think it is necessary to have handoff communication module within Al-Shifa?

    □ a. Yes

    □ b. NO, **If your answer no, move to question 32**

31. How would you like to use this handoff communication module?

    □ a. allow nurses to import patient's information directly from Al-Shifa

    □ b. allow nurses to manually enter patient information

32. Do you have a specific guidelines or policy that determine what information should be included during handoff report?

    □ a. Yes □ b. NO

Section III: Demographics information

33. Name of your department (Ward) _____

34. Your Gender is □ a. Male □ b. Female

35. Your nationality is: □ a. Omani □ b. Non-Omani

36. Your age is:

□a. < 25 □ b. 26-35 □ c. 36-45

□d. 46-55 □ e. >56

37. Your job title is:

□ a. Staff Nurse □ b. Senior Staff nurse □ c. Nursing Supervisor □ d. Nurse Administrator

38. Number of years you worked as nurse is:

□a. Less than 2 years □ b. 3-7 years □ c. 8-12 years

□d.13-17 years □e. more than 18 years

39. Number of years you have been using Al-Shifa:

□a. Less than 1 year □ b. 2-6 years □ c. 7-11 years □d. More than 12 years

40. Your highest level of education is:

□a. Basic Diploma

□b. Post-Basic Diploma

□c. Bachelor of Science in nursing

□d. Master of Science in Nursing

41. How would you rate your computer skills?

Very Poor	Poor	Fair	Very Good	Excellent

42. In your nursing program, did you learn how to give handoff report?

□ a. Yes □ b. NO c. Not sure

43. Did you receive any formal in-service training on what to include in a nursing handoff?

□ a. Yes □ b. NO c. Not sure

44. What changes if any would you like to see in the design of Al-Shifa to better serve your information needs during handoff

_____

_____

_____

Raffle Draw

45. Since you have completed the survey questionnaire you are entitled to join a raffle draw for free I-pad 2nd generation 16Gb with Wi-Fi. Would you like to join?

□ a. Yes

□ b. NO, **if your answer no, move to question 47**

46. To join the raffle draw you will have to provide your full name. Note: your name will not be associated with your responses.

□ a. Your Full name: _____

47. Would you be interested to be interviewed and observed by the researcher while you are giving handoff report?

□ a. Yes, I would like to be interviewed. My full name is: _____

□ b. Sorry, I don't want to be interviewed.

Thanks for filling out the survey,

You may now place it into an envelope and drop it off at the designated drop box located at the Education and Training Department.

Appendix B: Semi-structured interview

Investigator's Name: Said Alghenaimi, RN-MSN, MS Ed Tech. Project # 1195463

CONSENT FORM

DEAR REGISTERED NURSE,

My name is Said Alghenaimi and I am Doctoral Candidate at the University of Missouri, USA. I am a certified registered nurse and I work for Oman Nursing Institute as Nursing Tutor. Right now, I am working on my doctoral dissertation research project. My research is geared toward studying the practice of nursing handoff in Oman, particularly interested to know the role of electronic health records, Al-Shifa, in supporting the nurses' information needs during change of shift (handoff/handover) and to ensure the continuity of care across shifts.

INTRODUCTION

This consent may contain words that you do not understand or is not clear to you, please ask the investigator or the study staff to explain any words or information that you do not clearly understand. This is a research study that includes only people who choose to participate. As a study participant, you have the right to know about the procedures that will be used in this research study so that you can make the decision whether or not to participate. The information presented here is simply an effort to make you better informed so that you may give or withhold your consent to participate in this research study. You are being asked to take part in this study because you have specialized knowledge about patient's handoff/handover that occurs among nurses between shifts. In order to participate in this study, it will be necessary to give your written consent.

WHY IS THIS STUDY BEING DONE?

The purpose of this study is to explore handoff practices in Oman, identify the tools the nurses use to construct a common understanding about the patients' condition, and assess the nurses' satisfaction with the usefulness and ease of use of the electronic health records in structuring handoff communication and promoting effective and efficient transition of patient care during handoff.

HOW MANY PEOPLE WILL TAKE PART IN THE STUDY?

About a minimum of ten nurses will take part in this part of the study at the Royal Hospital in Oman.

WHAT IS INVOLVED IN THE STUDY?

During this part of the study, your consent will be needed for the interview and handoff observation.

HOW LONG WILL I BE IN THE STUDY?

You will require approximately 45 minutes for an interview, 45 minutes for observation of shift handoff. Member checking interview will be scheduled within two weeks after the first interview and will last for about fifteen minutes during which the researcher will show you summary of the first interview just to confirm the findings and the interpretations drawn from the first interview and observation. You can stop participating in this study at any time. Your decision to withdraw from the study will not affect you in any way.

WHAT ARE THE RISKS OF THE STUDY?

The potential risks for participating in this study are minimal but could include discomfort from probing questions during interviews and observations, and digital recording of the interview. All information collected will be de-identified as data are collected and analyzed.

ARE THERE BENEFITS TO TAKING PART IN THE STUDY?

If you agree to take part in this study, there may or may not be direct benefit to. You may expect to benefit from taking part in this research to contribute to research trying to improve the practice of nursing handoff and may identify ways to improve the design of Al-Shifa to better serve the nurses' information needs in the context of nursing handoff in Oman.

WILL I BE PAID FOR PARTICIPATING IN THE STUDY?

As you have already completed the survey questionnaire, this enlisted your name in a raffle draw to win a Brand New Apple iPad 2nd generation 16GB with Wi-Fi which will take place at one of your continuing education seminars within a month of completion of the study. The name of the winner will be circulated to all the participating units.

WHAT OTHER OPTIONS ARE THERE?

If you wish to withdraw from the study, you are free to do so. If you decide to withdraw, please inform the researcher and your information will not be used in this study as well as your name will not be included in the raffle draw.

WHAT ABOUT CONFIDENTIALITY?

Information produced by this study will be transcribed, coded and stored in a secured virtual private network at the Sinclair School of Nursing at the University of Missouri. The interviews will be transcribed within two weeks of the interview. In addition, the

digital file will deleted immediately after transcription. The code key connecting your name to specific information about you will be kept in a separate, secure location. Information contained in your records may not be given to anyone unaffiliated with the study in a form that could identify you without your written consent, except as required by law.

It is possible that your medical and/or research record, including sensitive information and/or identifying information, may be inspected and/or copied by the study staff in the course of performing their duties. If your record is inspected or copied by the study staff at the University of Missouri and/or Ministry of Health in Oman will use reasonable efforts to protect your privacy and the confidentiality of your medical information. The results of this study may be published in a medical book or journal or used for teaching purposes. However, your name or other identifying information will not be used in any publication or teaching materials without your specific permission.

WHAT ARE MY RIGHTS AS A PARTICIPANT?

Participation in this study is voluntary and you do not have to participate in this study if you do not want to. Your present or future work will not be affected should you choose not to participate. If you decide to participate, you can change your mind and drop out of the study at any time without affecting your work at the ***Royal Hospital.*** Leaving the study will not result in any penalty or loss of work benefits. In addition, the investigator of this study may decide to end your participation in this study at any time after ***he*** has explained the reasons for doing so. You will be informed of any significant new findings discovered during the course of this study that might influence your health, welfare, or willingness to continue participation in this study.

WHOM DO I CALL IF I HAVE QUESTIONS OR PROBLEMS?

You may ask more questions about the study at any time. For questions about the study or a research-related injury, contact *Said Alghenaimi* at *+968 96001567*.If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the University of Missouri Health Sciences Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-3181 or you can email irb@missouri.edu.

SIGNATURE

I confirm that the purpose of the research, the study procedures, the possible risks and discomforts as well as potential benefits that I may experience have been explained to me. To consent to take part in this research study, you must be a registered nurse working at any of the following eight units: Male Medical I, Male Medical II, Female Medical I, Female Medical II, Male Surgical, Female Surgical, Oncology, or Nephro-Urology units. I have read this consent form and my questions have been answered. My signature below indicates my willingness to participate in this study.

Participant Signature	**Date**

SEMI-STRUCTURED INTERVIEW GUIDE

Q1. Can you walk me through a typical nursing handoff at your unit? What information do you usually communicate during handoff? What methods do you use to convey this information to the next shift? Where does handoff take place at your unit? Could you please describe the handoff process at your unit? [One on one basis or one to group]

Q2. Ideally, to be able to assume patient care responsibility for the first time, what information would you like to know about your patient?

Q3. What documents do you use that help you communicate and exchange patient related information during handoff? What technologies do you use that help you communicate and exchange patient related information during handoff

Q4. Could you please describe to me how Al-Shifa is used before, during and after handoff? What features/functionalities in Al-Shifa help you during handoff? What features are missing from Al-Shifa that may help you during handoff? If so, could you tell me more about it?

Q5. Would you like to see any changes about handoff process and practice? What changes if any would you like to see if any changes in the design of Al-Shifa? If so, could tell me more about it?

Appendix C: Naturalistic Observation Guide

Hospital: _____ Unit: _____ Shift: _____

Date: _____ Time Started: _____ Time completed: _____

Staff involved: _____ Total # of Patient handed-off : _____

	Checklist		Remarks
Situation	• Patient Name • Bed number	• Date of Admission • Age	
Background	• Diagnosis • Laboratory results • Current Medication • Allergies	• Past surgical Hx • Past Medical Hx • Reason for admission	
Assessment	• Chief complaint • SPO2 • IV Lines • Wound condition • Lab result • Radiology results • Drains	• Vitals • Intake and output • IV fluids • Pre-operative preparation • Urinary catheterization • Physical exam finding •	
Recommendation	• Follow up • Discharge plan • Pending work	• Newly prescribed therapies • Referral/consultation • Scheduled for surgery	
Handoff Process & practice	• One-to-one • Reported at open area • Reported at bedside	• One-to-group • Reported at private room	
Artifacts used, Level of integration	• Cheat-sheet • Al-Shifa • Communication book	• Whiteboard at the nurse station • Paper-based medical record	
Other Notes:			

Appendix D: Permission letter

Dear Mrs. Carol,

Nursing Superintendent, Royal Hospital

My name is Said Alghenaimi and I am Doctoral Candidate at the University of Missouri, USA. I am a certified registered nurse and I work for Oman Nursing Institute as Nursing Tutor. Right now, I am working on my doctoral dissertation research project. My research is geared toward studying the practice of nursing handoff in Oman, particularly interested to know the role of electronic health records, Al-Shifa, in supporting the nurses' information needs during handoff and to ensure the continuity of care across shifts.

My research proposal has been reviewed and approved by the Research and Ethical Committee at the University of Missouri and the Ministry of Health, Oman.

My research consists to two phases:

In Phase I, survey questionnaire will include preliminary demographic information about the nurses as well as their perceived usefulness and ease of use of Al-Shifa during handoff. This phase of the study will take place in all the following nursing units: Male Medical I, Male Medical II, Female Medical I, Female Medical II, Male Surgical, Female Surgical, Oncology, or Nephro- Urology units. In Phase II, two units will be selected randomly from the above eight units, during which nurses will be interviewed followed by observations between shift nursing handoff reports.

Implication of the study:

Study findings may help policy makers in Oman to initiate reasoned policy that standardize the practice of nursing handoff in Oman. In addition, the study will identify

ways to improve the design of Al-Shifa to better serve the nurses' needs in the context of nursing handoff in Oman. This will promote information exchange during handoff, spare the shift overlap time for joint planning of patient care, eliminate informational gaps, and promote the effectiveness and efficiency of handoff practices, and improve the quality health care services in Oman.

Furthermore, participants will be entered into a raffle draw for the chance to win an iPad2, which will take place at one of your continuing education seminars within a month of completion of the study.

I am grateful for your participation and input.

If you have questions about your rights as a research participant, you may discuss your concerns with Waleed in the Research and Ethical Review & Approve Committee at the Ministry of Health at 24697551or email: waleed.s@moh.gov.om or contact University of Missouri Health Sciences Institutional Review Board at (573) 882-3181 or you can email irb@missouri.edu.

I can be reached with any questions or concerns at +968 96001567 or said198@hotmail.com

Said Alghenaimi

Appendix E: Flyer

Volunteer Nurses are Wanted for a Research Study

The Role of Electronic Health Records in Structuring Handoff Communication and Maintaining Situation Awareness among Nurses during Handoff

If you are a registered nurse working at any of the following units: Male Medical I, Male Medical II, Female Medical I, Female Medical II, Male Surgical, Female Surgical, Oncology, or Nephro-Urology units, you are eligible to participate in this study.

Implication of the study:

Your participation in this research will contributes to research trying to improve the practice of nursing handoff and may identify ways to improve the design of Al-Shifa to better serve the nurses' needs in the context of nursing handoff in Oman.

Your participation will include completing approximately thirty- minutes online survey found at the Royal Hospital Website. By completing the survey, your name will be entered into a raffle/drawing for the chance to win an iPad2 16GB with Wi-Fi. You may also volunteer to be interviewed and observed by the researcher while you are giving handoff report. Your refusal to take part in or withdrawing from this study will involve no penalty.

If you are interested in participating in this study please fill in the survey questionnaire circulated at your wards. You may also request a blank copy from Brother Khalid Al-Busaidi at the Education and Training department. If you have any question or concern, please feel free to call the researcher Said Alghenaimi at 96001567 or email said198@hotmail.com

Appendix F: University of Missouri Institutional Review Board Approval

Health Sciences IRB
University of Missouri-Columbia

190 Galena Hall; Dc074.00
905 Hitt Street
Columbia, MO 65212
PHONE: (573) 882-3181
FAX: (573) 884-4801

This project was reviewed and approved by the University of Missouri – Columbia Health Sciences Institutional Review Board (HSIRB) according to the terms and conditions described below:

Project Number	1195463
Project Title	The Role of Electronic Health Records in Structuring Handoff Communication and Maintaining Situation Awareness among Nurses during Handoff
Principle Investigator	Alghenaimi, Said Amur
Primary Contact	Alghenaimi, Said Amur
Approval Date	Jun 30, 2011
Expiration Date	Jun 30, 2012
CIDB Version/Date	: -
Consent Version/Date	-
Protocol Version/Date	NA: NA -
Research Risk Level	Minimal Risk
Type of Review	Expedited, Category 7
Consent Types	Written; Waiver of documentation of consent
Study will be documented in the medical record	No
HIPAA Authorization	Not Required

All documents reviewed and approved can be found in digital documents and are highlighted green.

You are expected to comply with the requirements outlined in the MU HSIRB Policies (http://research.missouri.edu/hsirb/policies.htm). This includes reporting any unanticipated problems involving risk to research participants or others.

Changes in the conduct of the study, including consent process or materials, require submission of an amendment form which must be approved by the HSIRB *prior* to implementation of the changes. Changes in the source of study funding must also be reported.

Information related to Board membership, FWA or Board Conflicts of Interest may be found at http://research.missouri.edu/hsirb/index.htm

According to federal regulations, this project requires IRB continuing review. As such, prior to the expiration date above, you must submit either a Continuing Review Report (CRR) or the Completion/Withdrawal Form. If you have questions or require additional information, please contact us at (573) 882-3181 or irb@missouri.edu

Sincerely,

Niels Beck, PhD
Chair

Appendix G: Research & Ethical Review Committee at the Royal Hospital Approval

SULTANATE OF OMAN
MINISTRY OF HEALTH
DIRECTORATE GENERAL OF ROYAL HOSPITAL

سلطنة عمان
وزارة الصحة
المديرية العامة للمستشفى السلطاني

14th September, 2011

To:
Mr. Said Al Ghunaimi

Subject: Ethical Approval Request for: ***"The role of electronic health records in structuring handoff communication and maintain situation awareness among nurses during handoff" MESRC#64***

Thank you for submitting the above mentioned proposal. It is my pleasure to inform you on behalf of Medical Ethics & Scientific Research Committee that your request has been approved, and you can now start your research.

Wish you a productive study.

Best Regards,

DR. ZAHID AL MANDHARI
SENIOR CONSULTANT
ACTING HEAD, RADIATION ONCOLOGY
ROYAL HOSPITAL

Dr. Zahid Al Mandhari
Medical Ethics & Scientific Research Committee
Sr. Consultant, Department of Oncology
Royal Hospital

P.O. Box 1331, Muscat Airport, Postal Code 111

ص.ب ١٣٣١، مطار مسقط، الرمز البريدي: ١١١

Appendix H: Factor Analysis

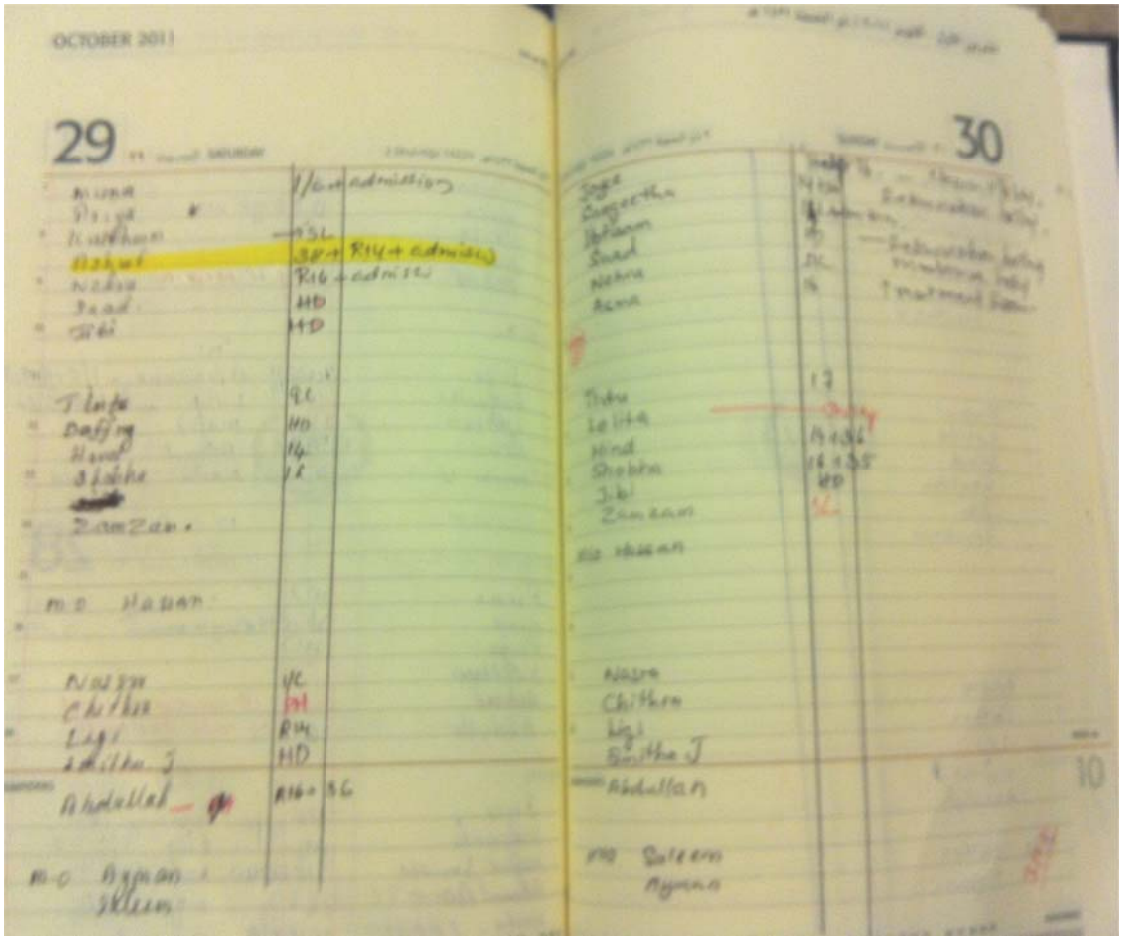
	Component		
	PU	PEU	PQ
1. Using Al-Shifa enables me to give handoff report more quickly.	**0.78**	-0.06	0.08
2. Using Al-Shifa during handoff improves my job performance.	**0.75**	0.26	0.17
3. Using Al-Shifa during handoff increases my work productivity.	**0.58**	0.22	0.09
4. Using Al-Shifa enhances the effectiveness of handoff communication.	**0.61**	0.33	-0.21
5. Using Al-Shifa makes it easier to give handoff report.	**0.73**	0.30	0.24
6. I find Al-Shifa useful when giving handoff report.	**0.82**	0.23	0.14
7. Learning to use Al-Shifa is easy for me.	0.14	**0.69**	0.05
8. I find it easy to get Al-Shifa to do what I want it to do	0.02	**0.69**	0.05
9. My interaction with Al-Shifa is easy for me to understand	0.09	**0.72**	0.39
10. I find Al-Shifa to be flexible to interact with.	0.27	**0.60**	0.22
11. It is easy for me to become skillful at using Al-Shifa.	0.24	**0.73**	0.05
12. I find Al-Shifa easy to use.	0.20	**0.77**	0.18
23. The use of Al-Shifa during handoff promotes the continuity of care.	**0.45**	0.28	**0.49**
24. When using Al-Shifa during handoff, it takes shorter time to complete handoff report.	0.30	-0.06	0.22
25. When using Al-Shifa during handoff, it facilitates consistent information exchange between shifts	0.16	0.05	**0.86**
26. I am satisfied with the quality of handoff report that I receive.	0.09	0.26	-0.17
27. Using Al-Shifa during handoff enhances the accuracy of the information exchanged.	0.15	0.31	**0.80**

Rotation Method: Varimax with Kaiser Normalization.

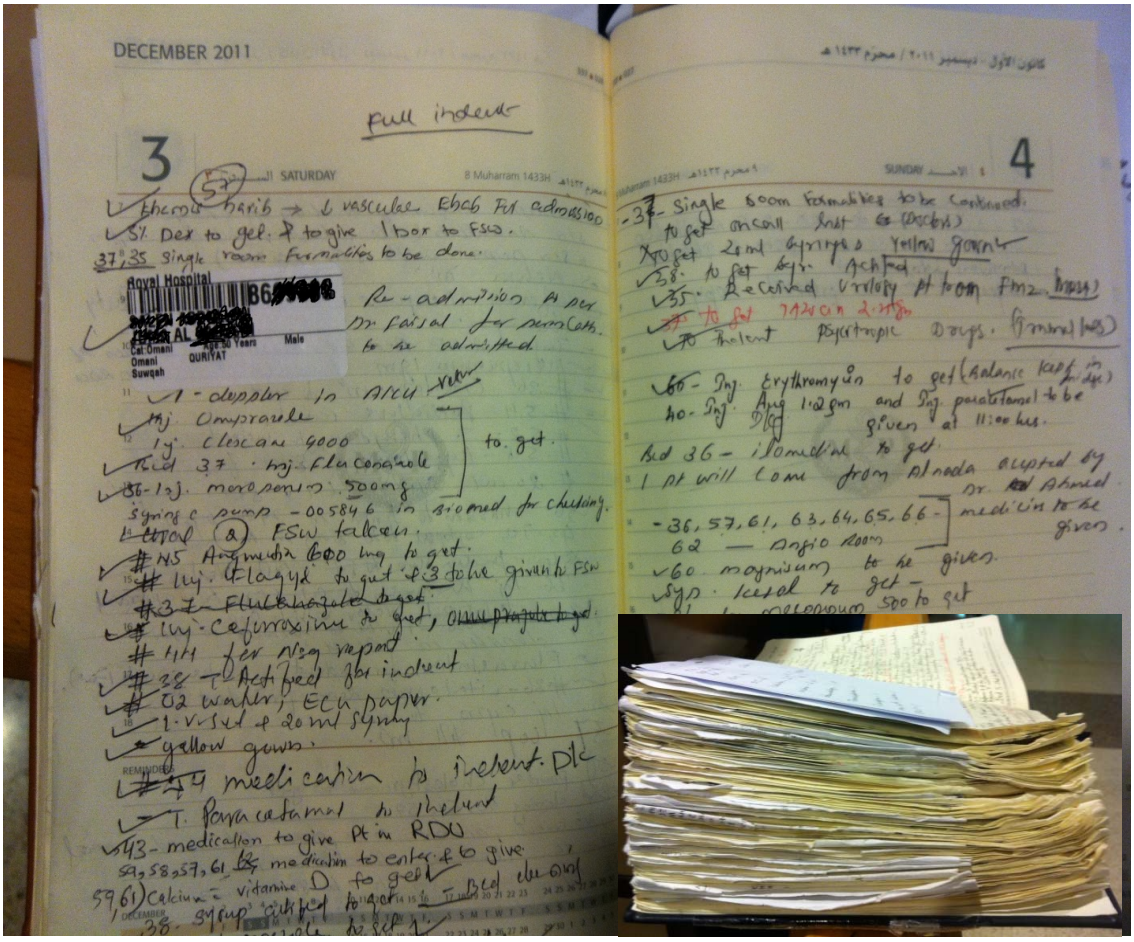
Appendix I: Overview of interview respondents' demographics

Code	Gender	Nationality	Age	Job title	Level of experience	Number of years using Al Shifa	Level of education	Computer skills
RN1	Female	Omani	26-35	Registered nurse	3-7 years	2-6 years	Basic Diploma	Fair
RN2	Female	Omani	26-35	Registered nurse	3-7 years	2-6 years	Basic Diploma	Very Good
RN3	Female	Omani	26-35	Registered nurse	3-7 years	2-6 years	Bachelor of Science in nursing	Excellent
RN4	Male	Non-Omani	46-55	Registered nurse	More than 18 years	7-11 years	Post-Basic Diploma	Fair
RN5	Male	Omani	26-35	Charge Nurse	13-17 years	2-6 years	Post-Basic Diploma	Very Good
RN6	Female	Omani	< 25	Registered nurse	3-7 years	2-6 years	Basic Diploma	Very Good
RN7	Female	Omani	26-35	Charge Nurse	3-7 years	2-6 years	Basic Diploma	Fair
RN8	Female	Omani	< 25	Registered nurse	3-7 years	2-6 years	Basic Diploma	Fair
RN9	Female	Non-Omani	36-45	Registered nurse	3-7 years	2-6 years	Basic Diploma	Very Good
RN10	Female	Non-Omani	36-45	Registered nurse	3-7 years	2-6 years	Basic Diploma	Fair
RN11	Female	Non-Omani	26-35	Registered nurse	3-7 years	2-6 years	Bachelor of Science in nursing	Fair
RN12	Female	Omani	< 25	Registered nurse	3-7 years	2-6 years	Basic Diploma	Very Good
RN13	Female	Non-Omani	36-45	Registered nurse	3-7 years	2-6 years	Basic Diploma	Very Good
RN14	Female	Omani	26-35	Charge Nurse	13-17 years	2-6 years	Post-Basic Diploma	Very Good

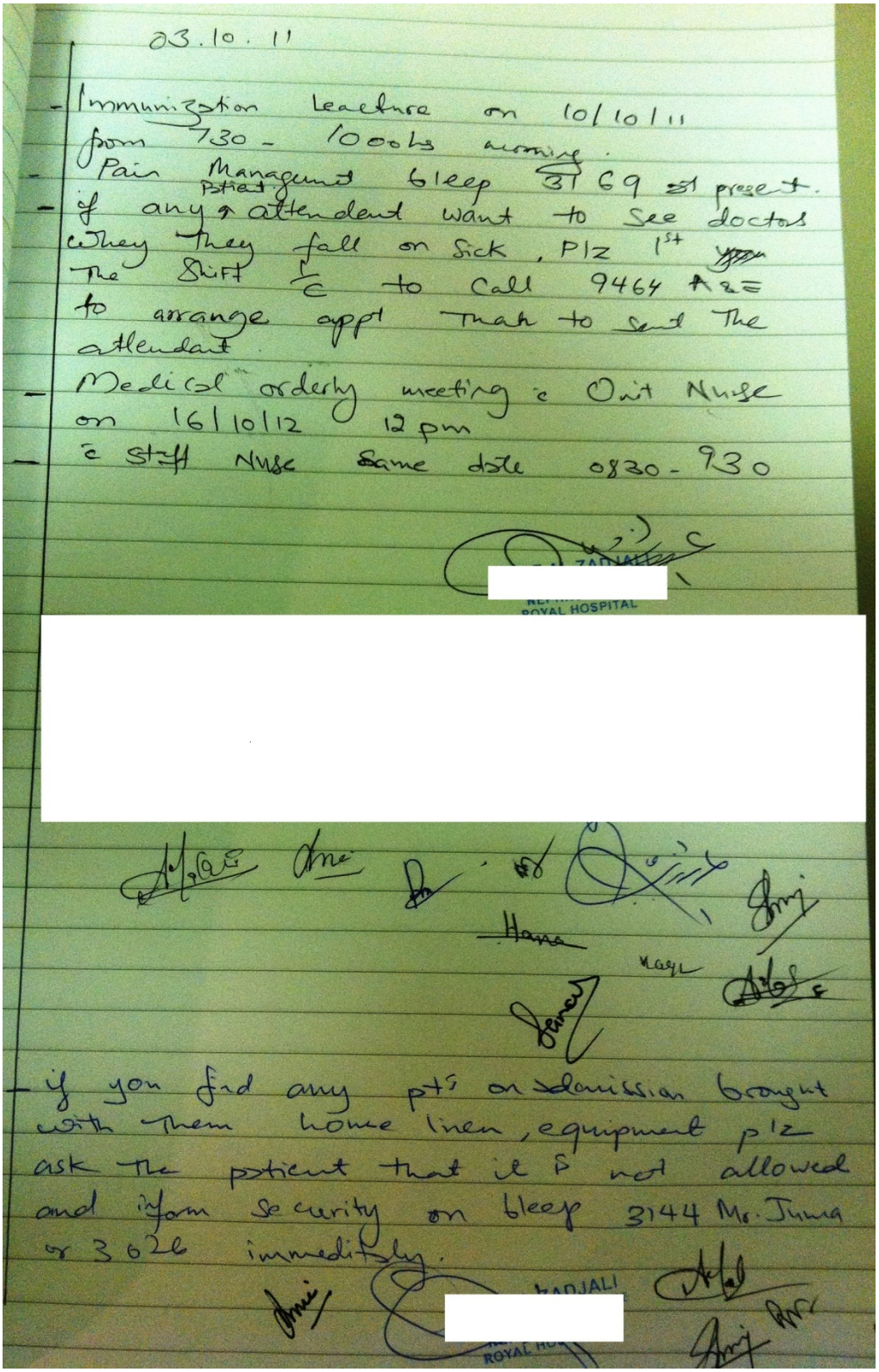
Appendix J: Staff Assignment Diary



Appendix K: In-charge Communication Book



Appendix L: Staff Communication Book

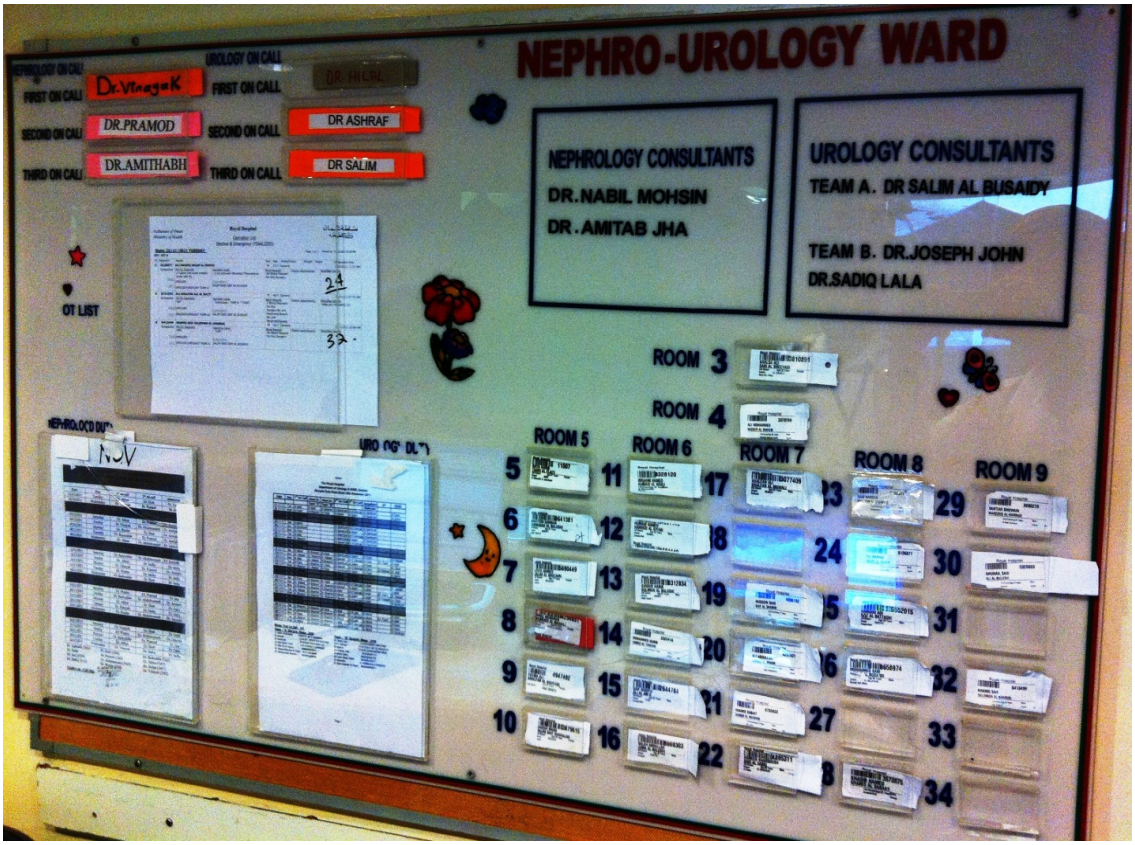


23.10.11

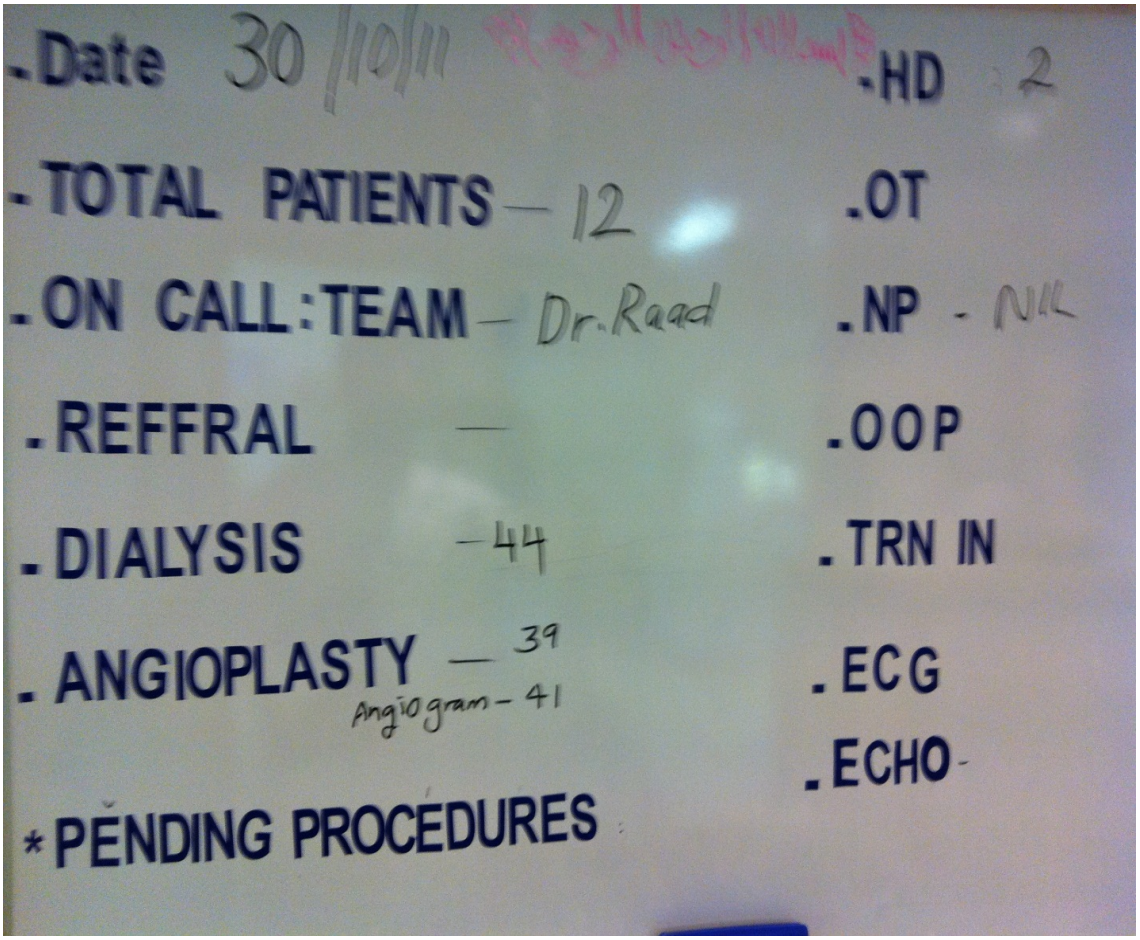
- Immunization Leacture on 10/10/11 from 730 - 1000hs morning.
- Pain Management bleep 3169 present.
- if any attendent want to see doctors when they fall on sick, plz 1st the Shift to call 9464 to arrange appt than to send the attendant
- Medical orderly meeting c Unit Nurse on 16/10/12 12 pm
- c Staff Nurse same date 0830 - 930

- if you find any pt's on admission brought with them home linen, equipment plz ask the patient that it is not allowed and inform Security on bleep 3144 Mr. Juma or 3026 immediately.

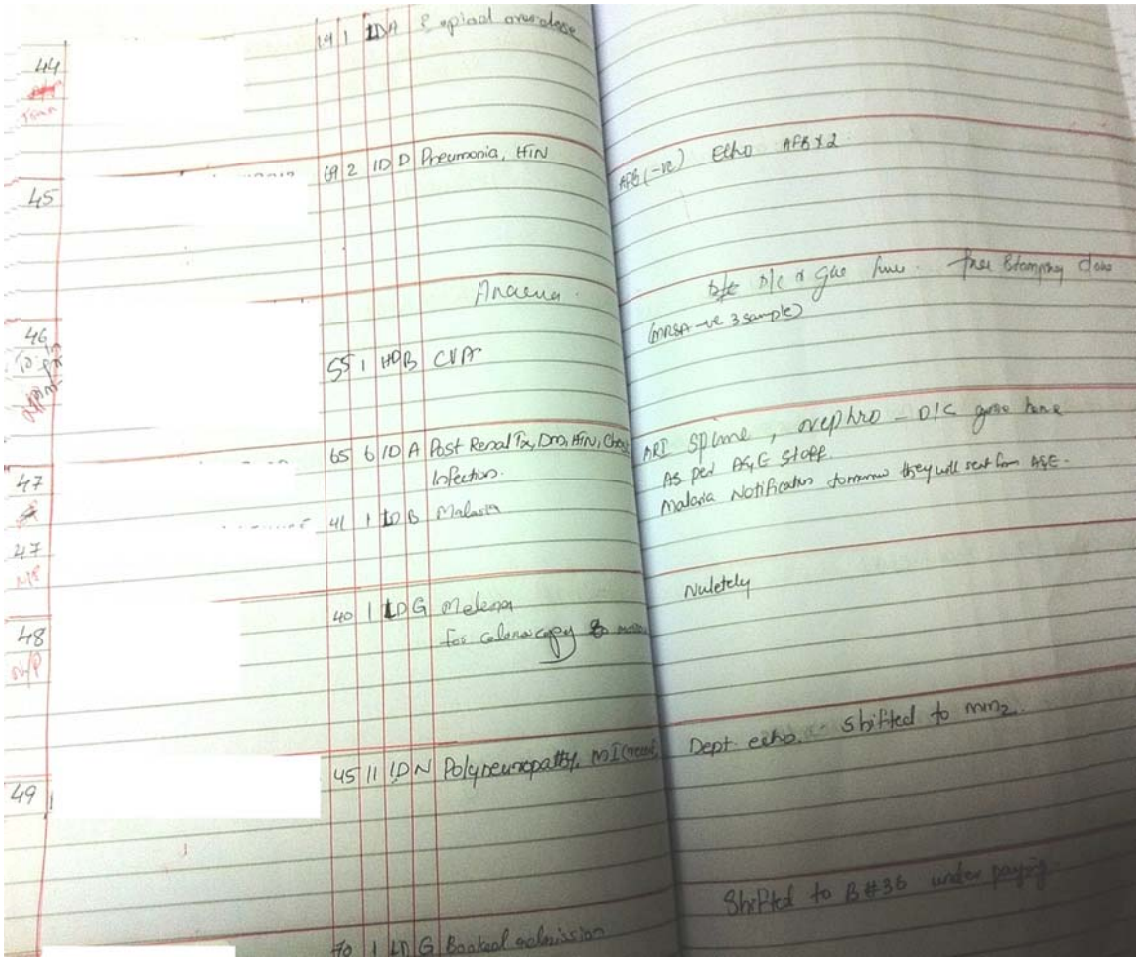
Appendix M: Bulletin board



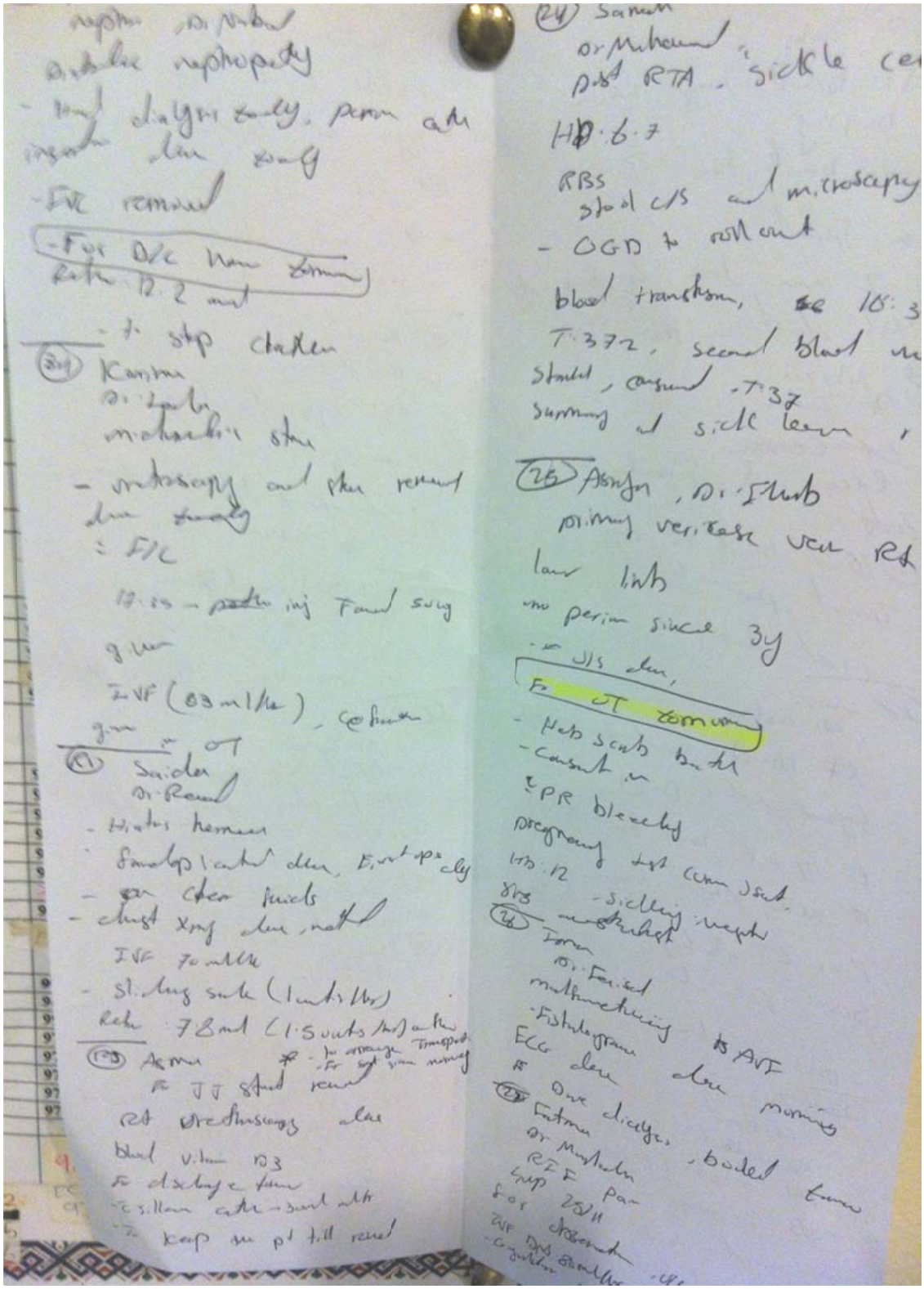
Appendix N: Whiteboard



Appendix O: Rounds' book

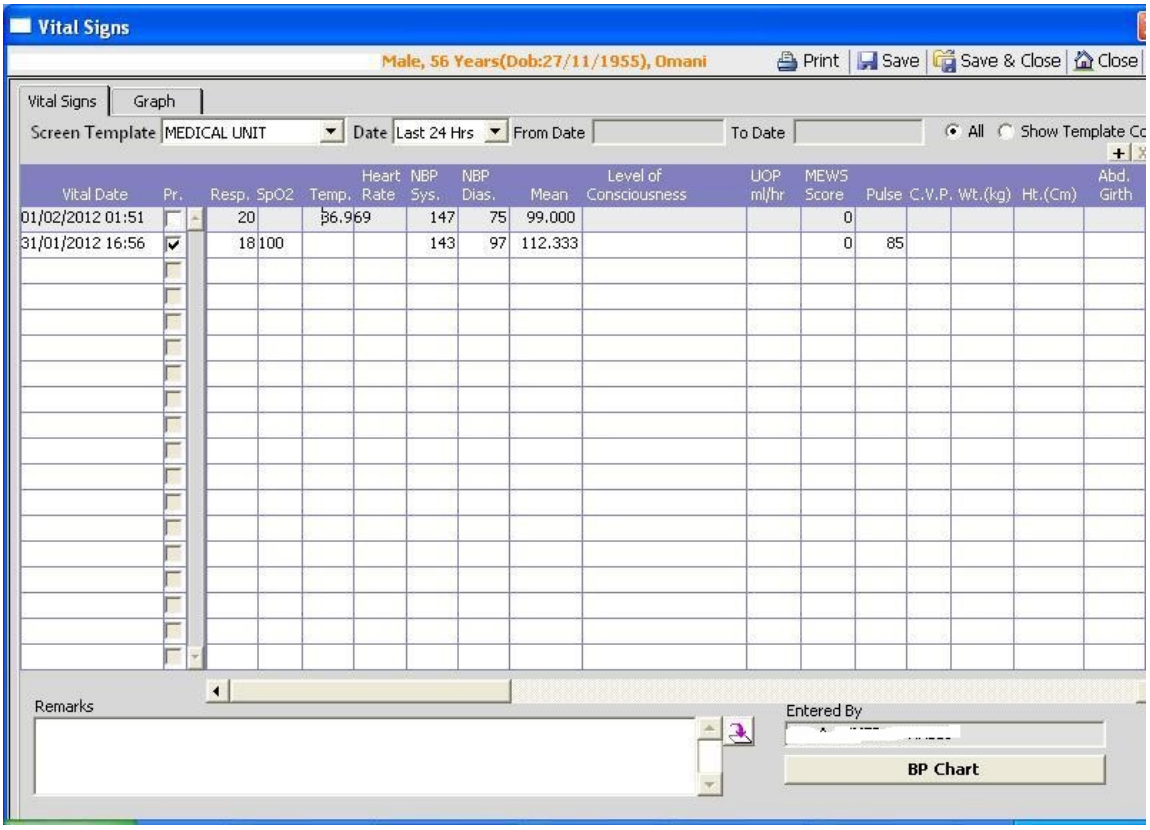


Appendix P: Piece of paper

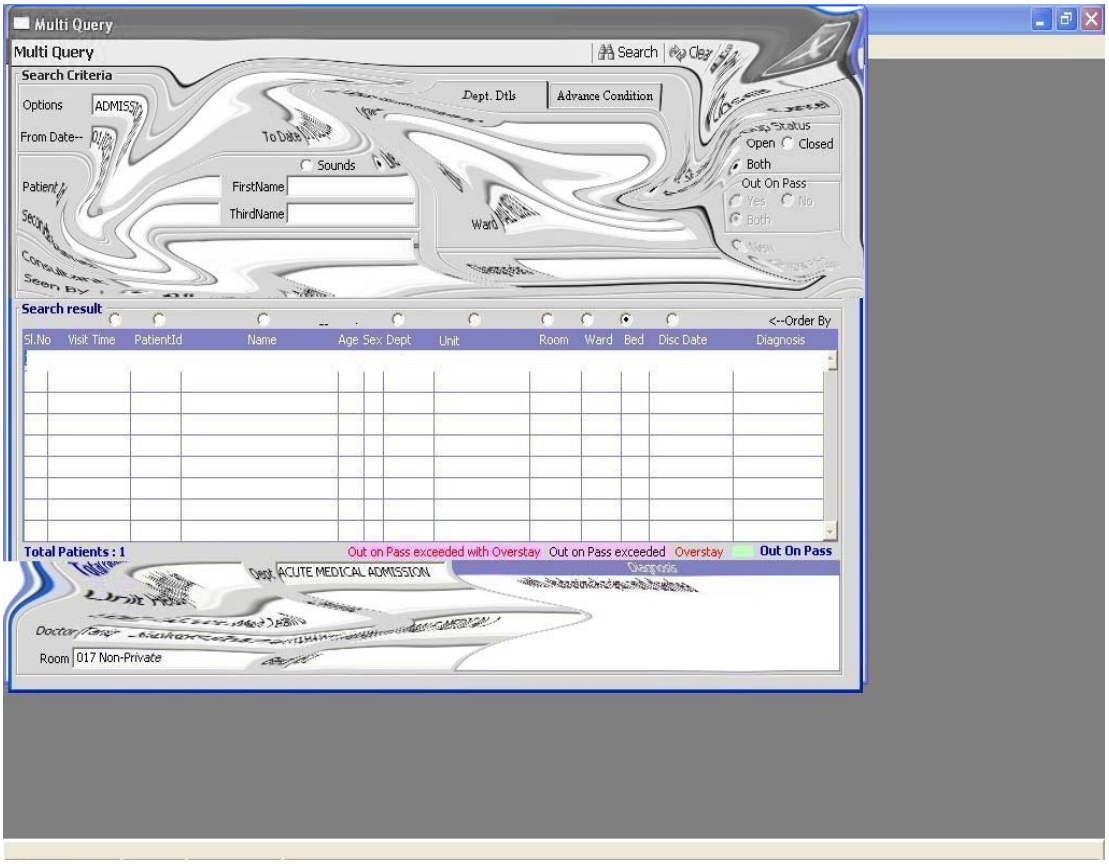


Appendix Q: Al-Shifa Homepage

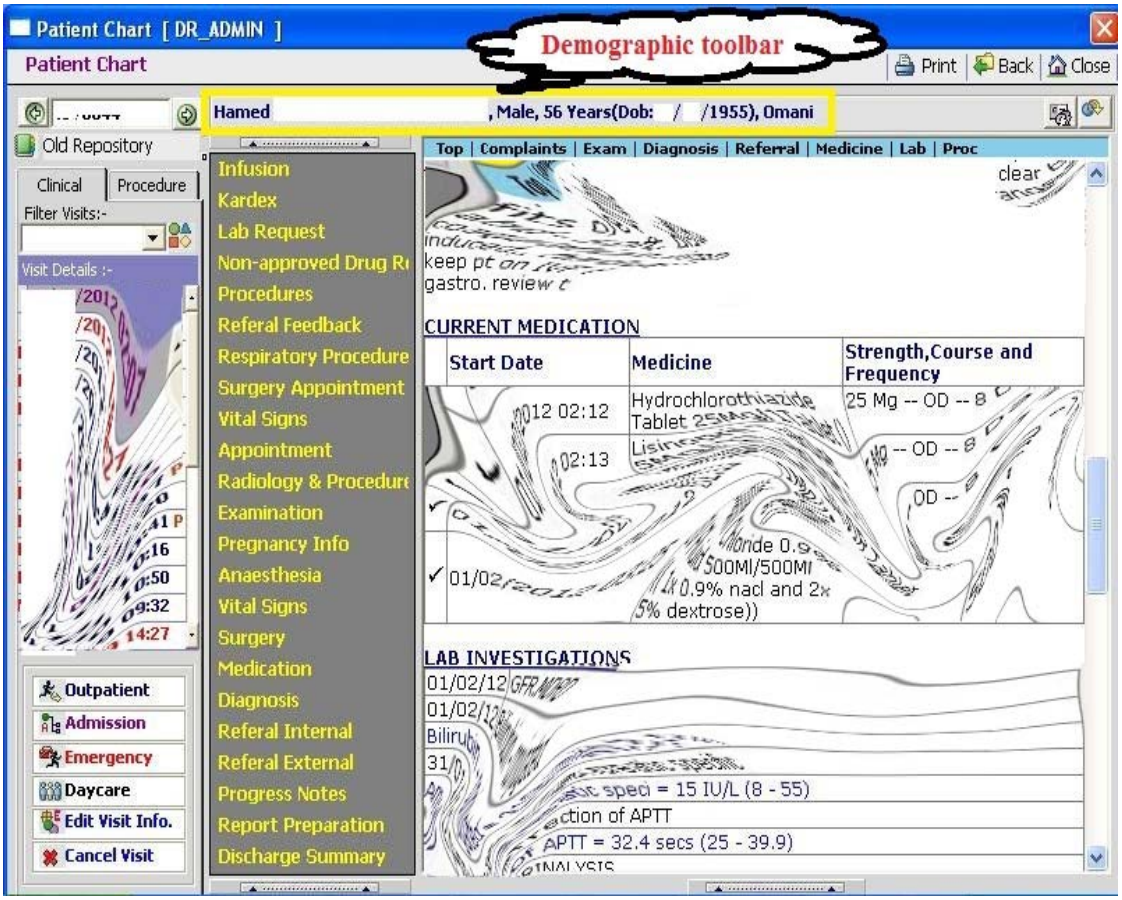
Appendix R: Screen capture of Al-Shifa Nursing Care Management Module



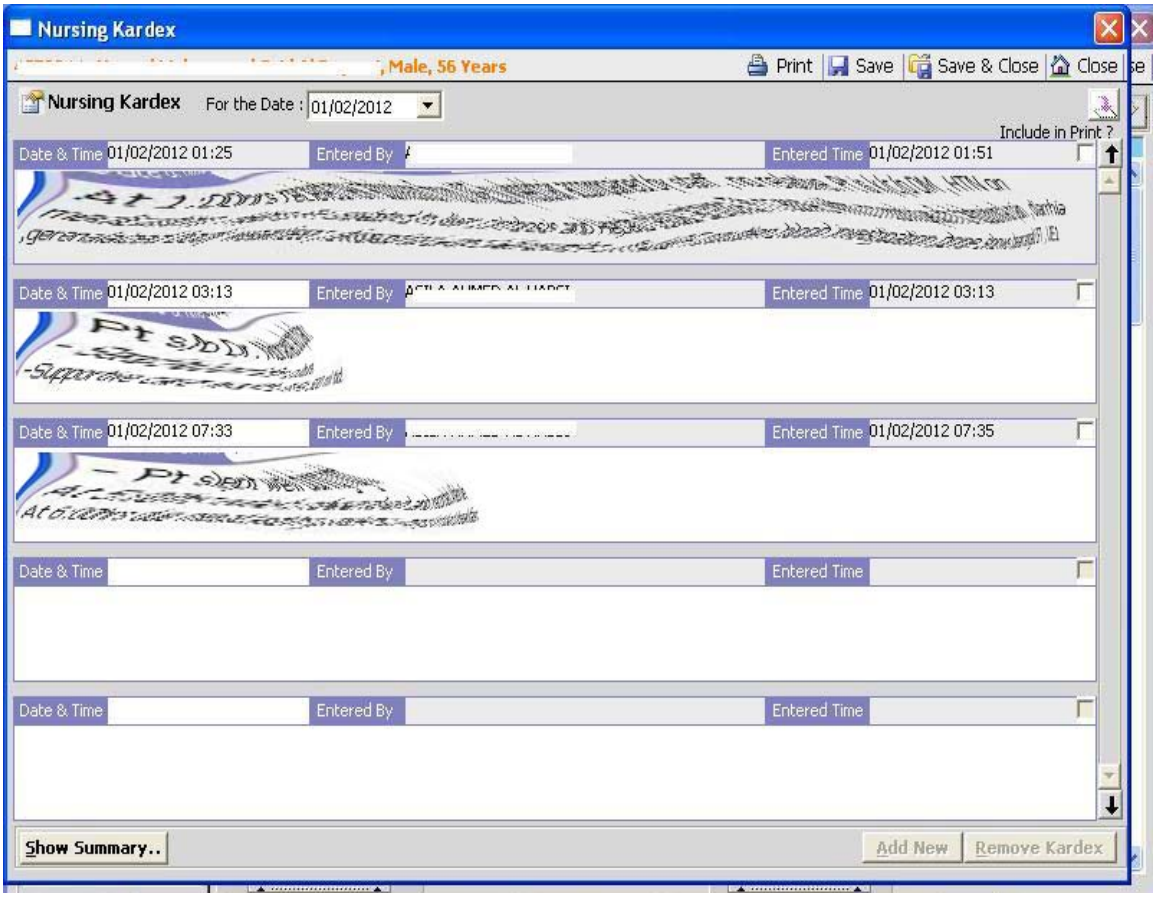
Appendix S: Inpatient list



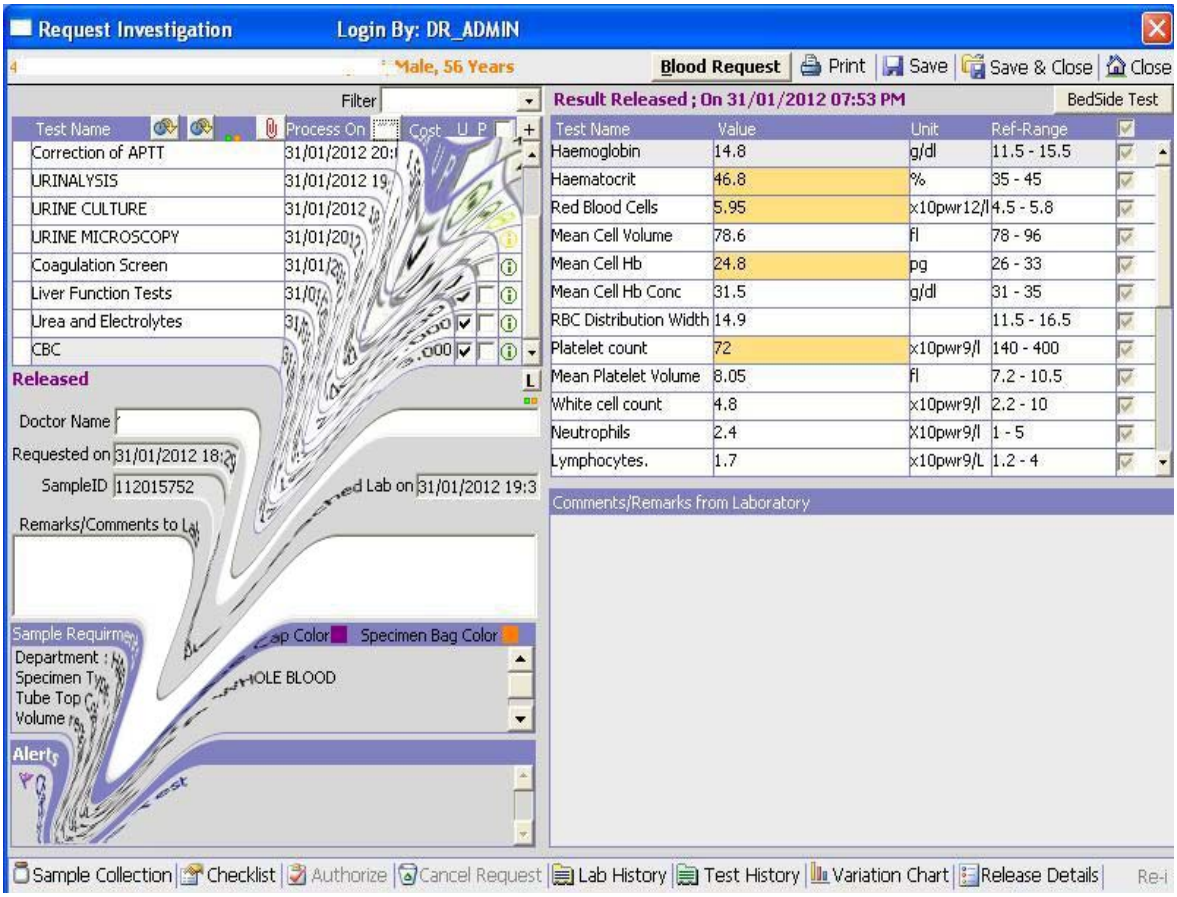
Appendix T: Demographic Information toolbar



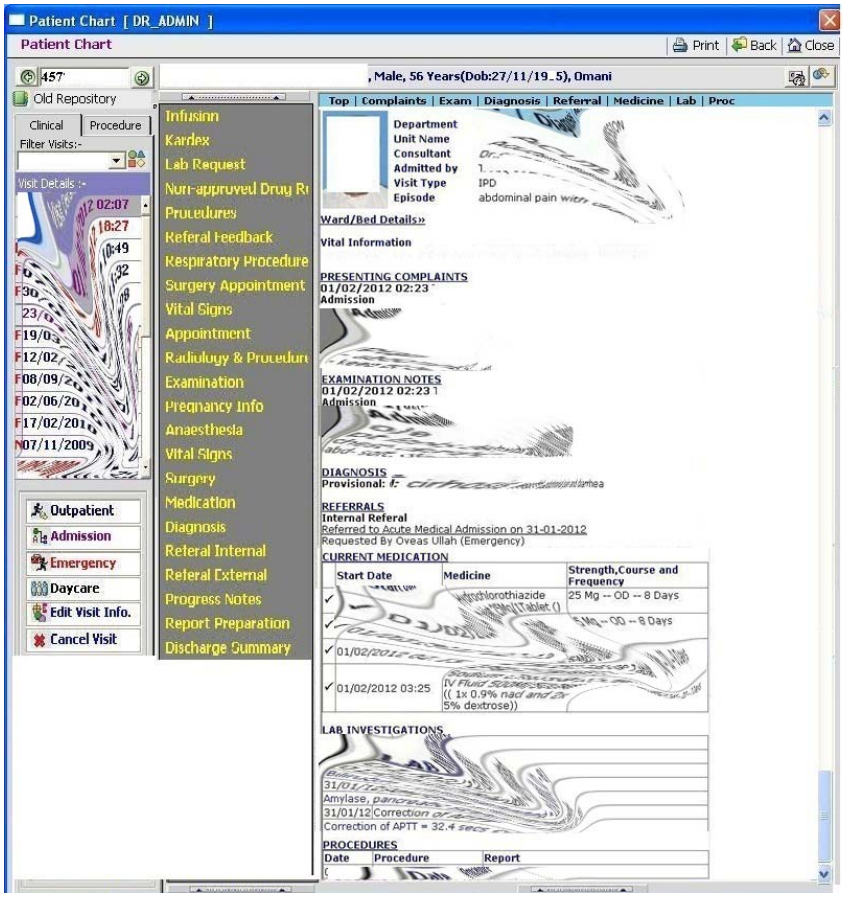
Appendix U: Nursing Kardex



Appendix V: Laboratory Module



Appendix W: Patient chart summary



Appendix X: Coding Scheme

Code	Category	Reference
1.	Typical nursing handoff 1a. process and practice 1b. Staff involvement 1c. Length of Handoff 1d. Location	This category refers to information pertaining to the typical nursing handoff that the nurses described during the interview and the handoff observations. This category also includes information that the researcher collected during handoff observation with regard to the context of the nursing handoff, staff involvement and the duration of handoff. Example of the information coded in this category include: … This is the second Night … the incoming nurses know their patients' assignment ... … When I start my work as a shift in-charge, the first thing I do is … Then, I will check the inventory ... … we start our shift handover at the …, where the previous shift nurses take turns in giving over of their patients … Once we are done with patients' handover, then … … during handoff, we cannot sit and listen to

		what they say, we ask for specific information about the patient.
2.	Al-Shifa use surrounding nursing handoff 2a. Use of Al-Shifa before handoff 2b. Use of Al-Shifa during handoff 2c. Use of Al-Shifa after handoff	This category is used in referring to the nurses' use of Al-Shifa before, during and after the handoff. This category is used to code information obtained from the observation, factor analysis and nurses comments. Example of the information coded in this category include: …The outgoing nurses, spent the end of their shift reviewing their Kardex entry and ensuring the completeness of their documentation. … outgoing nurse reviewed the doctor's progress notes and copied and pasted new doctor plan into the Nursing Kardex and re-written it into nursing action. … I rarely use Al-Shifa before handover [incoming nurse]…, we don't browse the system before endorsement [incoming nurse]. … We use Kardex, which summarizes all the things we have done for the patient and all the pending work the coming shift has to carry

		out. … During endorsement, I read the receiving notes that I have written in the Nursing Kardex in which I have summarized the doctor progress notes as well as the information that I have received from the previous shift.
3.	Artifacts the nurses used to communicate and exchange information between shifts 3a. Digital artifacts 3b. Non-Digital artifacts	In this category, the nurses identified the artifacts they used to communicate and exchange information between shifts. In addition, this category summarizes the findings of the artifact analysis and observation of handoff report. Example of the information coded in this category include: … During endorsement, we only read from Al-Shifa … we mainly depend on the information documented in nursing Kardex. … Each of the outgoing nurses logged into Al-Shifa, then read patient history from patient chart, followed by Kardex, retrieved pending blood work from the lab module. … We document all patients' care in the

		Nursing Kardex in Al-Shifa. … We have the assignment book in which we write staff assignment to which room. … Bedside nursing care plan include the following forms… … We use the in-charge handover communication book where the shift in-charge write all the important things about … … We also use the Whiteboard to communicate vital information between the nurses and the paramedical team such as … … We use a small piece of paper to summarize the information we received from the previous shift. … We use staff communication book to communicate information about…
4.	Information usually communicated during handoff (Content of Handoff) 4a. Information about unit's routines 4b.Key information related to patient's care	This category presents the information that the nurses communicated during handoff. Example of the information coded in this category include: …The outgoing nurse started with bed number, followed by case of … under team … admitted on …. For …Then present the

	• SBAR (Assessment) • SBAR (Background) • SBAR (Recommendation) • SBAR (Situation)	history of the patient … Then opened the Nursing Kardex and read the information documented in the Kardex. … The key information that we would like to know about the patient include … … We also need to know the patient condition that include whether the patient is … … I need to know patient's medical and surgical history …
5.	Features or functionalities in Al-Shifa that are helpful during handoff	This category refers to the features and functionalities that the nurses perceived to be useful for them during handoff. In addition, this category is also used to report the finding of the artifact analysis. Example of the information coded in this category include: … The most important feature in Al-Shifa is the Nursing Kardex, which help us to document and pass information from one shift to another. … Kardex is the most helpful during handoff, which summarizes the patient condition, the treatment received and any pending

		procedures that we need to finish in the upcoming shift. … During endorsement, we use the medication and lab modules to get up-to-date information about the patient on and see recently released reports. … Al-Shifa eliminated handwriting-related issues …, we can edit/update our Nursing Kardex …, the documentation became clear, neat … this eliminates unnecessary confusion for the coming shift.
6.	Features that are missing from Al-Shifa that maybe helpful during handoff	This category refers to the features and functionalities that are missing in Al-Shifa that the nurses perceived to be useful for them during handoff. In addition, this category is also used to report the finding of the artifact analysis. Example of the information coded in this category include: … Al-Shifa does not show the patient's bed number along with the demographic information. … Al-Shifa help us during endorsement is

		that all information is all in electronic health record … Patient chart summary contain information about the patient name, and his age, referrals, the current medications the patient is getting, lab investigations, procedures … but our Kardex and vitals does not appear in the patient chart summary. …system does not provide alert of newly ordered medication, … we don't know unless we check each individual patient's medication chart or incidentally know the new medication
7.	Suggested changes in the handoff process and practice	This category refers to the suggested changes made by the nurses in the handoff process and practice. Example of the information coded in this category include: … I'd rather prefer to have one paragraph at the end of the shift that summarizes the care given to the patient, any changes in patient's condition or treatment plan and any other pending work that… … we should have a policy that specifies the information that we should include during

		handover… … I prefer to have one-to-one endorsement after night-off because this …
8.	Suggested changes in the design of Al-Shifa to fit the nurses' informational needs during handoff.	This category refers to the suggested changes made by the nurses in the design of Al-Shifa to fit the nurses' informational needs during handoff. Example of the information coded in this category include: … It would be great if we have an alert within Al-Shifa, indicating changes in the … … When the nurse open the patient chart, the alert will appear … … It would be good to have checkbox beside the patient list…, this will enable the endorsing nurse to … … I'd like handoff communication module which will …, This way, the overlap time between shifts could be utilized for …

Appendix Y: Permission to Adapt Technology Acceptance Model

Dear Dr. Davis

April 11, 2011

I am a doctoral candidate at the University of Missouri. Right now I am working on my dissertation and I am planning to assess the nurses acceptance of the Electronic Medical Record during Hand-off (Time between shift change). While I was doing my lit review, I came across the tool that you have developed in 1989. I would like to adapt your tool to test the nurses perceived usefulness and ease of use of the Electronic record in delivering quality hand-off report. The study will take place overseas which broaden the horizon of your scale to be used in a different sociocultural environment.

May I have the permission to adopt your survey tool, Technology Acceptance Model?

Thanks, your help is highly appreciated well in advance

Regards, Said Alghenaimi, RN-MSN, M.Ed.-Tech

Reply

Dear Said

You have my permission to adopt the technology acceptance model for your dissertation research.

Best wishes,

Fred Davis

Appendix Z: Summary of Handoff Observations (N =20)

Observations	Duration of handoff report (time in minutes)	Nurses who gave handoff reports (outgoing nurses)	Nurses of received handoff report (incoming nurses)	Total Patients Handed-off
1	26	3	6	22
2	27	4	4	19
3	24	4	4	18
4	36	6	4	23
5	17	1	6	10
6	29	1	4	10
7	42	4	6	24
8	24	4	4	12
9	45	3	4	14
10	30	3	5	17
11	21	1	4	22
12	25	2	4	23
13	44	2	7	27
14	35	2	4	22
15	40	4	4	15
16	60	5	4	18
17	85	4	6	23
18	30	5	6	21
19	42	3	5	18
20	90	4	6	24
Total	**772**	**65**	**97**	**382**

Vita

Said Amer Alghenaimi undertook his doctoral degree at the University of Missouri in the School of Information Science and Learning Technologies. He holds Bachelor of Science in Nursing (2001) from Villanova University, USA. Upon graduation, Said worked as registered nurse for four years in Oman. In 2005 Said Obtained a Master of Science in Nursing from Villanova University. He taught in the nursing program at Oman Nursing Institute three years. To keep abreast with the growing technologies in nursing education, Said obtained a Master of Education Technologies from the University of Missouri (2009). Currently, he works as a nursing Tutor at Oman Nursing Institute, Oman. His research interest include: Education Technologies, Human Information Behavior, and Health Informatics.