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Clinical information systems are being introduced into nurses' work at an alarming rate. These systems are implemented with limited input from nurses who provide direct patient care, and without considering human factors in the systems design and implementation process. The need for nurses to be involved at every level of decision-making as it relates to technological innovation into their work is imperative to mitigate system failure and truly support their work. Therefore, the purpose of this paper is two-fold: 1) to discuss evidence that suggests that the nurse is not really viewed as an end user in most clinical information systems implementations and 2) to describe the implications of this misperception to the nurse, organization, and nursing profession.

#### Headings:

Nurses' Work Environment

Information Technology Adoption

Knowledge Worker

Knowledge Readiness

Sense-making

Organizational Behavior

NURSES' WORK ENVIRONMENT & TECHNOLOGICAL INNOVATION  
ADOPTION: ACQUIRING KNOWLEDGE AFTER MAKING SENSE OF IT ALL

by  
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## DEDICATION

In loving memory of my handsome little brother, Michael Wayne Pickney aka "Mike P",  
you have touched many people's lives with your humor and nurturing ways. May God  
hold and keep you until we meet again.

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## ABBREVIATIONS

AACN	American Association of Colleges of Nursing
AHRQ	Agency for Healthcare and Research Quality
AMIA	American Medical Informatics Association
AHA	American Hospital Association
ANA	American Nurses Association
BLS	Bureau of Labor Statistics
BMA	Bar coded medication administration
CIS	Clinical Information Systems
CTDs	Cumulative Trauma Disorders
EPR	Electronic Patient Record
HCI	Human-Computer Interaction
HFE	Human Factors Engineering
HRSA	Human Resources and Services Administration
IC	Intellectual Capital
IS	Information Services
IT	Information Technology
IOM	Institute of Medicine
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
MSDS	Musculoskeletal Disorders
NACNEP	National Advisory Council on Nurse Education and Practice
NIOSH	National Institute of Occupational Safety & Health

NANDA	North American Nursing Diagnosis Association
NI	Nursing informatics
NIRM	Nursing Innovation Readiness Model
NIRS	Nursing Innovation Readiness Survey
NIC	Nursing Intervention Classification
NOC	Nursing Outcome Classification
OITIM	Organizational Information Technology Innovation Model
OSHA	Occupational Safety and Health Administration
QSEN	Quality and Safety Education for Nurses
RN	Registered Nurse
SOP	Standards of Practice
SOC	Standards of Care
SDLC	Systems Development Life Cycle
TIGER	Technology Informatics Guiding Educational Reform
US	United States
WMA	Wireless medication administration

## CHAPTER 1

### Introduction

In a 2004 Institute of Medicine (IOM) report, “*Keeping Patients Safe: Transforming the Work Environment of Nurses*”, patient safety risk factors associated with changes in nurses’ work and their environment were described. These factors include: increase in the care of acutely ill patients, shorter hospital stays, inefficient use of nursing staff through redesign initiatives, declining numbers of nursing staff to care for sicker patients, frequent patient turnover, longer working hours, rapid increases in new knowledge and technology and increased interruptions and demands on nurses’ time. Furthermore, nurses are burdened by increasing documentation needs to demonstrate appropriate patient care and mitigate legal risks (Sabo, 1999). The changing workplace, in conjunction with being primary clinical information system users, situates nurses in the middle of complex technological systems to provide safe, quality care.

Nurses rely on extensive clinical information and highly specialized knowledge to implement and evaluate the processes and outcomes of their clinical decision making (Snyder-Halpern, Corcoran-Perry, Narayan, 2001). Moreover, nurses are constantly challenged to effectively manage and communicate clinical data while increasing their knowledge base. “Rapid proliferation of new knowledge, expanding professional practice expectations, and dynamic and uncertain practice environments require that nurses become lifelong learners capable of constantly reflecting on and modifying their practice” (Snyder-Halpern, et. al., 2001: p. 17). However, clinical information systems

are implemented with limited input from nurses who provide direct patient care (Ball & Bierstock, 2007; Ball & Douglas, 2005; Ballard, 2006). Health care organizations should work to preserve the capital assets of this (nurses) worker in order to improve their work environment thereby ensuring favorable patient outcomes.

Healthcare is evolving from a task-based industry to a knowledge-based one. Nurses are traditionally coined a vocation of task performers (Simpson, 2007). Because of this aforementioned designation, nurses are not often seen as intellectual capital (IC) although their work requires critical thinking, creative thinking, problem solving and decision-making (Schwirian & Moloney, 1998). However, health care organizations measure nursing IC in numbers (Simpson, 2007). Nurses' work entails acquisition of knowledge through rapid introduction of new technologies---knowledge based systems---into their practice. Often times, these knowledge-based systems are introduced with limited input from nurses, although these task performers are often cited in the literature as being the largest group of clinical information system end users. Furthermore, old structures governing nursing practice (the same structures that encourage cursory involvement of nurses in system solutions) fail to promote and celebrate nursing intellectual capital use in innovating the delivery of care (Porter-O'Grady, 2001).

Dr. Nick Bontis, a world renowned expert in intellectual capital defined IC by three categories: human capital—the talent base of the employee, structural capital—the nonhuman storehouses of information, and relational capital, also known as customer capital—the knowledge embedded in business networks (Bontis, 2002). Of the three categories, human capital is what most people think of as IC---and for nursing, human capital is the most endangered form of IC. This is partly due to an 8.5% national RN

vacancy and the difficulty of hospitals to recruit RN staff (American Hospital Association, 2005).

Due to inadequate staffing levels which are attributed to the nursing shortage, nursing IC must be measured by knowledge instead (Simpson, 2007). However, nursing knowledge has not been measurable because nursing has been without a language to truly capture the work they perform. Organizations can only count as IC the knowledge workers that they can measure (Simpson, 2007). “Nursing must come up with ways to quantify nursing-specific languages that will allow organizations to codify tasks and compile them into a working knowledge.” (Simpson, 2007; p. 87). The complexity of the nurses’ work, the changing environment, and the ongoing introduction of new technologies creates a fertile ground for undesirable patient outcomes or error, suboptimal utilization of technologies designed to enhance care and communication and role dissatisfaction for the nurse.

### *Problem Identification*

The 1999 IOM report, “*To Err is Human: a Safer Health System*” estimated that more than a million injuries and close to 100,000 deaths occur each year in health care organizations due to medical errors. This report called for a national effort to include establishment of public reporting of adverse events, development of safety programs in health care organizations, and attention by regulators, health care purchasers, and professional societies (Charatan, 2000). After the release of the aforementioned report, Congress initiated sessions and “President Clinton requested that the Agency of Healthcare Research and Quality (AHRQ) look into the issue and fund, at the local or state level, processes that can reduce errors” (Koshy, 2005; p. 189S).

In addition to the IOM report, the *Chicago Tribune* (Berens, 2000) reported that since 1995, at least 1,720 patients have been accidentally killed and 9,584 others injured from the actions or inaction of nurses across the country, who have seen their daily routine radically altered by cuts in staff and other belt-tightening measures in United States (U.S) hospitals. Due to the seriousness of the aforementioned data, professional and health care organizations such as the Leapfrog Group, the Joint Commission on Accreditation of Health care Organizations (JCAHO) and others began to re-examine efforts in patient safety (Bates & Gwande, 2003; Thomas, Sherwood & Helmreich, 2003). These same organizations are calling for the increased use of technological communication and information systems as solutions for the medical error problem.

As a result of the IOM report, most health care organizations have increased the implementation of clinical information systems (CIS). In another IOM report (2001), “*Crossing the Quality Chasm: A New Health System for the 21st Century*”, it was

emphasized that healthcare organizations “should be supported by systems that are carefully and consciously designed to produce care that is safe, effective, patient-centered, timely, efficient and equitable”. However, of those health care organizations that have implemented clinical information systems (CIS), an estimated 50% of CIS implementation projects in hospitals fail (Kaplan, 2000).

Implementation failure not only costs significant time and resources, but also can negatively impact an organization in other ways. For instance, hospital workers who experience a failed implementation are at risk for having negative views of CIS implementation, thus, making future implementation more difficult. Additionally, pressure to adopt an unfriendly system may result in staff frustration, decreased satisfaction, and staff turnover (Dennis, Sweeney, MacDonald & Morse, 1993; Ngin, Simms & Erbin-Roesemann, 1993; Smith, Smith, Krugman & Oman, 2005). Nurses represent the largest group of CIS users. Therefore, nurses can greatly impact the user acceptance of a new CIS.

User acceptance can drive a group towards readiness for a new system and subsequently implementation success (Pickney & Huels, 2007). Perceived usefulness and perceived ease of use have been identified as elements of user acceptance (Davis, 1989). *Perceived usefulness* is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989: p. 320). If a system is high in perceived usefulness, then a user may believe in existence of a positive use-performance relationship (Davis, 1989). *Perceived ease of use* is defined as the “degree to which a person believes that using a particular system would be free of effort” (Davis, 1989: p. 320). Perceived usefulness and perceived ease of use both contribute to

the level of readiness among users, who are to implement a new system into their daily work (Pickney & Huels, 2007).

A negative perception of a new system can lead to unintentional documentation and/or patient care errors through system work-a-rounds or worse, system abandonment (Englehardt & Nelson, 2002). Nurses must view the new system favorably. Moreover, the system needs to “make sense” to its users as it fits with the work of nurses and other healthcare professionals. The concept of “sensemaking”, primarily influenced by research conducted by Weick (1995), has mainly been used in organization theory and analysis. It has been applied to the information science (IS) field only to a minor extent (Bansler & Havn, 2006; Jensen & Aanestad, 2007).

Sense-making involves the ongoing retrospective development of plausible images that rationalize what people are doing (Weick, Sutcliffe, & Obstfeld, 2005). Furthermore, sensemaking is about understanding how people construct meaning and try to make it stand out as rational to themselves and others. Action is important for understanding, i.e., people act and thereby they create the environment in which they take part. The environment that is created then enables as well as constrains the actions of the actors (Weick, 1995). Orlikowski & Gash (1994) contend that people in the sensemaking process develop particular expectations and assumptions of a technology, which then shape their subsequent action towards it.

A system’s negative impact on nurses could contribute to existing challenges in the nursing profession, such as decreased nurse satisfaction, the shortage of nurses, and the high cost of nurse turnover (Bates, et al. 2001; Bauerhaus, et al, 2005; Hunt, Sproat & Kitzmiller, 2004; Jones, 2005). The work environment has been noted to be directly

correlated with nursing dissatisfaction in the results from two large national surveys conducted in 2002 and 2004 (Bauerhaus, et. al., 2005; Ulrich et al, 2005). As for the monetary cost to the organization when a nurse leaves, a study by Jones (2005) showed that nurse turnover costs equated to 1.2 to 1.3 times the average RN salary. Between 1990 and 2004, the estimated cost of turnover per registered nurse ranged from \$10,100 to \$64,000. Therefore, finding ways to prevent possible negative effects of technological implementation on nursing staff can be a valuable asset to the health care organization's bottom line as well as the nursing profession.

The rapid proliferation of clinical information systems into nurses' environment further complicates their work. Often times, health care organizations may provide adequate support for more tangible needs such as the software, hardware, and IS personnel during implementation. However, they often fail to provide less tangible support, the human component. This human component includes adequate training, adequate resources during critical phases (i.e., more staff on the floor when staff are learning how to navigate a new system, the utilization of nurse super users for peer-to-peer training), and allowance of paid time away from the bedside to participate in project decisions and planning (Bates, et al. 2001; Connors, Weaver, Warren & Miller, 2002; McNeil, et al. 2003; Staggers, Gassert & Curran, 2002; Thede, 2003; Windsor, 2006). Human factors are only a mere fraction of what health organizations need to ensure proper utilization of health information systems by clinicians. Johnson, Johnson & Zhang (2005) contends that designing and implementing a health information system is not so much an IT project as a human project about human-centered computing such as

usability, workflow (i.e., ergonomics), organizational change, medical error, and process reengineering.

Human-centered design practice is commonplace in the aviation and locomotive industries, automobiles, consumer software and electronics, and nuclear power plants (Johnson, et al., 2005; Patterson, Roth, Woods, Chow, Gomes, 2004). In fact, these “high-consequences for failure” industries are similar to the high demands of health care in terms of safety standards and the need to maintain a high level of reliability (Rogers, Patterson, Chapman, & Render, 2005; Patterson, et al., 2004). Rogers et al (2005) go on to state that, ‘in each of the fields, the role and impact of the information system is heightened because of the immediate effect on human lives’ (p. 366). However, the present culture of healthcare organizations is more apt to train clinicians to adjust to inadequately designed systems, rather than tailor fitting the systems to its users either through participation in design or utilizing knowledge of system failures for system update purposes.

In addition to the lack of consideration for the human and other non-tangible technological issues associated with failed CIS projects, health organizations often underestimate the amount of support and training nurses need throughout the Systems Development Life Cycle (SDLC). The lack of informatics competencies by nurses, as well as other health care professionals, in work settings (ANA, 2007; AMIA, Lui, Pothiban, Zhuoren & Khamphonsiri, 2000; Staggers, et al., 2002), and in formal academia (ANA, 2007; Smith, 2006; Staggers, et al., 2002) is a reality that further perpetuates the plight of health organizations. Nursing settings are becoming complex

computer environments and all nurses should be proficient, competent, and literate in the use of information and communication systems in general, not just clinical systems.

Although a clinical information systems can lead to increased data exchange as well as data analysis between hospital departments, a 1996 study by Parker & Abbott showed that an alarming 58% of surveyed health organizations spent less than 4% of their budget on IT, and only 11% spent 5% or more. “To capitalize on the power of IT in health care organizations, executives must be committed to fully supporting the acquisition and maintenance of an adequate system” (Barr, 2002; p. 1085). Moreover, nurses accomplish their work by engaging in the roles of data gatherer, information user, knowledge user, and knowledge builder (Snyder-Halpern, et al., 2001). Therefore, health organizations must optimize all of its resources to fully support nurses’ use of information systems.

Under-staffing and a growing nursing shortage is also detrimental to health organizations and adds further burden to nurses work environment. According to Aiken, et al., (2002), nurses have voiced their concerns that hospital nursing staffing levels are inadequate to provide safe and effective care. Forty to sixty percent of nurses reported frequently missing meals and breaks, feeling increased pressure to finish their tasks, a lack of sufficient support staff, and working mandatory overtime, thus increasing dissatisfaction with the nursing work environment (Goodin, 2003). Moreover, 40% of hospital nurses have burnout levels that exceed the norms for health care workers (Aiken, et al., 2002). Aiken et al., (2002) goes on to add that job dissatisfaction among hospital nurses is 4 times greater than the average for all U.S workers, and 1 in 5 hospital nurses report that they intend to leave their current jobs within a year. Moreover, staff nurses (as

opposed to nurses in administrative or management positions) consistently reported the lowest levels of satisfaction across hospital, nursing home, ambulatory care, and the community health settings (IOM, 2004). This dissatisfaction is linked to the departure of nurses from the workforce (IOM, 2004; ANA, 2001).

Decreased satisfaction was also related to a perceived lack of opportunities to influence organizational decisions about nursing work and, subsequently, a lack of control over the work that nurses do (Laschinger, Sabiston, Kutzcher, 1997; Ulrich, et al., 2005). Only 40% of hospital nurses reported that they have opportunities to participate in decision-making within their practice (Aiken, et al., 2001). Optimizing the quality of care through health information systems that truly support the knowledge work and decision-making capabilities of nurses could improve their practice environment (Englehardt & Nelson, 2002). However, these systems are implemented with limited input from nurses who provide direct patient care (Ballard, 2006), and does not capture the true measurement of nurses knowledge work (Simpson, 2007).

Pickney & Huels (2007), in an effort to conceptualize nurse readiness to technological innovation adoption, developed the *Nurse Innovation Readiness Model* (NIRM). The NIRM was based on Dr. Rita Snyder's Organizational Information Technology Innovation Model (OITIM). This conceptualization was tested with the use of the "Nursing Innovation Readiness Survey" (NIRS) among sixty-five staff nurses and nursing assistants from a medical-surgical unit prior to implementing an Electronic Patient Record (EPR) system. Despite communication methods (i.e., newsletters, kick-offs, etc.) used by the health care organization and IS department, the nursing staff were not knowledgeable of the system or its benefit to their work environment at the time they

completed the survey. As stated previously, the more nurses know about the informational tools used to support the care they provide at every stage of the SDLC, the more clinicians will accept technological innovation into their work. Therefore, the purpose of this paper is twofold: 1) to discuss evidence that suggests that the nurse is not really viewed as an end user in most clinical information systems implementations and 2) to describe the implications of this misperception to the nurse, organization, and nursing profession.

## CHAPTER 2

### Conceptual Framework

The Nurse Innovation Readiness Model (NIRM) is the conceptual framework that will guide this paper (see *Figure 1*). Studies (Synder-Halpern, 1999; Synder-Halpern, et al., 2001; Synder & Fields, 2006) have assessed staff readiness as part of a broader organizational construct, but fewer studies focus attention on nurses and assessment tools needed to gauge their readiness for technological innovation into their work environment. Pickney & Huels (2007) recognized this need and constructed the Nurse Innovation Readiness Model (NIRM), along with a Nursing Innovation Readiness Survey (NIRS) tool developed after a review of published studies addressing staff and/or nurse readiness for technological innovation. Nurse Readiness involves all the factors contributing to how well nurses are prepared for implementation and how they perceive both the new technology and the activities involved with implementation. Nurses are the largest users of clinical information systems. Therefore, ways to capture their readiness for innovation into their work environment is imperative for acceptance and proper utilization of these systems into nurses' work.

The NIRM, based from Snyder's Organizational Information Technology Innovation Model (OITIM) (see *Figure 2*), was tested among sixty-five staff nurses and nursing assistants from a medical-surgical unit prior to implementing an Electronic Patient Record (EPR) system. Although participants surveyed stated they were proficient with computer skills, researchers found that the staff was not knowledgeable of the

benefits of this new technological innovation into their work environment. As knowledge workers, nurses must understand and master the use of patient-centered IT tools to operate within a patient-focused model of care and maximize their value as intellectual capital (Simpson, 2007).

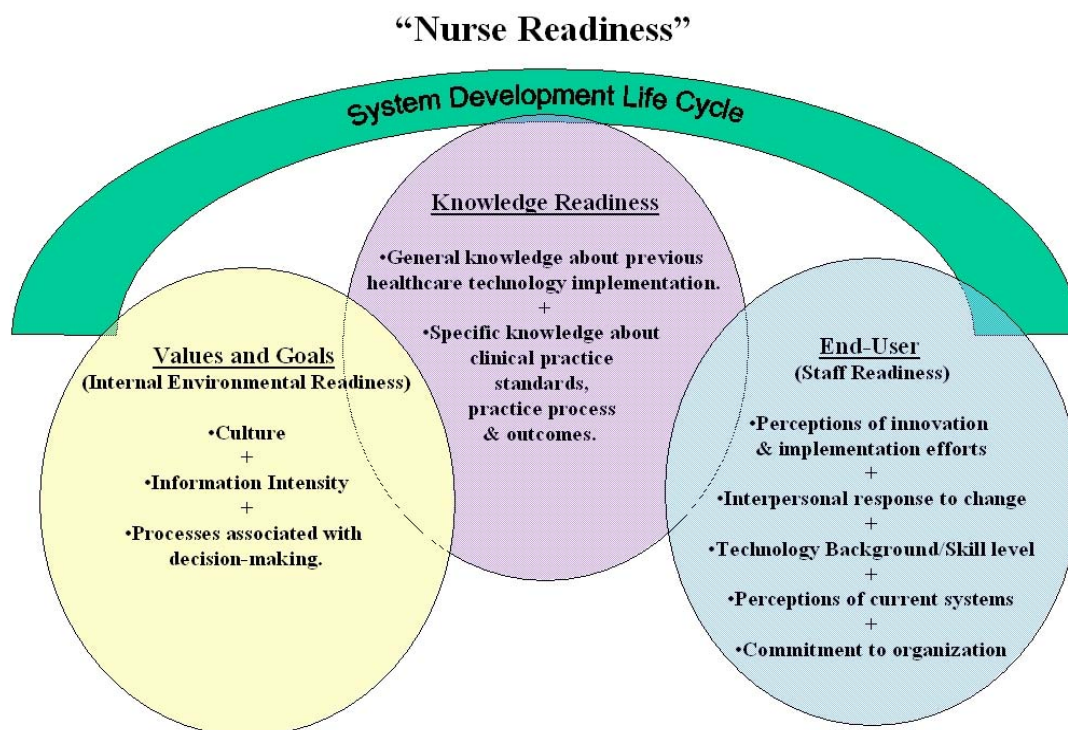


Figure 1. Nurse Readiness Conceptual Model, Pickney & Huels, 2007

The components of the nurse readiness conceptual model include: *Knowledge Readiness*, *Internal Environmental Readiness* and *Staff Readiness*. *Knowledge Readiness* includes both specific knowledge and general knowledge. Specific knowledge encompasses the nurse's understanding of clinical practice standards, practice processes, and patient outcomes (standards of care [SOC] and standards of practice [SOP]). *Internal Environmental Readiness* includes the value and goals, the culture, bureaucracy level, information intensity, management/leadership style and processes involved with decision

making among the social group of end-users (Lorenzi, 1997; Snyder-Halpern, 1999). Finally, *Staff Readiness* involves human factors, such as technology skill and comfort level, satisfaction with currently used technology, level of commitment to the organization (number of years worked) and interpersonal response to change (Davis, 1989; Lorenzi & Riley, 1995; Snyder-Halpern, 1999; Snyder & Fields, 2006). Because Pickney & Huels (2007) found that the staff were not knowledge ready to the benefits of the new technological innovation into their work environment, concentrating on the Knowledge Readiness component (see *Figure 3*) of the NIRM will be used to guide this discussion.

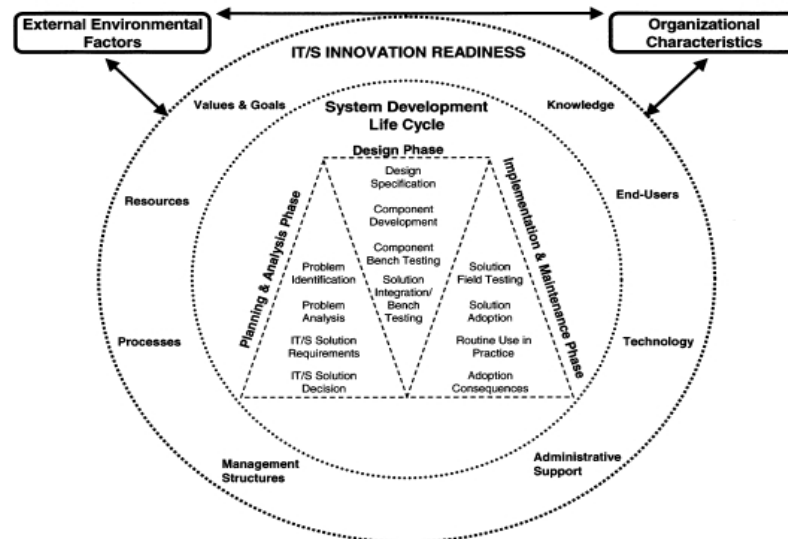


Figure 2. Organizational Information Technology Innovation Model (OITIM), Snyder-Halpern, 2001.



*Figure 3.* Knowledge Readiness Sub-component, Pickney & Huels, 2007

## CHAPTER 3

### Literature Review

A review of the literature revealed several themes that relate to nurses' work environment, the introduction of technological innovation into this environment, and nurses' involvement at all stages of the SDLC. The following sections provide an in-depth review of some of the most pertinent research studies pertaining to the aforementioned variables and how these variables further complicate nursing work practice. First, a description of the nurses' work environment and the necessity for proper acquisition of knowledge-based systems are explored.

#### *Nurses' Work Environment*

Restructuring initiatives has impacted the nursing work practice environment (Aiken, et al., 2001; IOM, 2004). Lake (2002 a) defines the nursing practice environment as the "organizational characteristics of a work setting that facilitate or constrain professional nursing practice" (p. 178). Nurses' work entails a large amount of time integrating and coordinating patient care. This time is dependent on direct as opposed to indirect care. IOM defines direct patient care as any activities performed in the presence of the patient and family, such as performing a nursing assessment, administering medications, and performing treatments and procedures. Indirect patient care involves those activities that are carried out away from but on behalf of the patient, such as collaborating with other members of the health care team, seeking consultations, preparing medications, and documenting care (Division of Nursing, 1978).

Nurses reported spending time delivering and retrieving food trays, performing housekeeping duties, transporting patients and ordering, coordinating, or performing ancillary services (Aiken, et al., 2001). Although, some of these “indirect” duties are shifting to the bedside, as in computerized documentation, studies (Hendrickson, Doddato, & Kovner, 1990; Prescott, Phillips, Ryan & Thompson, 1991) have found that nurses spend as much as 24% to 25% of their time performing indirect care activities. Due to the many features that exist in health care organizations in conjunction with the complexity and unpredictability of nursing work, the nursing practice environment is difficult to measure (Lake, 2002 a). However, measuring and regularly evaluating the nursing work environment has become a crucial way to address the nursing shortage, prevent nursing vacancies and promote positive patient and nurse outcomes (Aiken et al, 2001). Interestingly, the work environment is also a critical aspect of the systems solutions proposed by the IOM reports, *To Err is Human* and *Crossing the Quality Chasm*.

#### *Nurses Involvement in Decision-making*

Due to the vertical structure of the hospital environment, nurses may not have control of their own work environment or have input into decision-making (Laschinger & Havens, 1996). In a study by Aiken, et al (2001), only 40% of hospital nurses reported that they have opportunities to participate in decision-making within their practice environment. Ulrich et al (2005) found that half of the RNs surveyed in their study (N= 3500) did not have adequate opportunities to influence workplace decisions.

Nurses are constantly making rapid decisions about patients, who health status may change minute by minute in an environment with numerous interruptions. As a

result, nurses constantly organize and reorganize the priorities and tasks of care to accommodate patients' fluctuating status (Potter et al., 2005). Moreover, little has been done to study the effects of "interruptions" on the cognitive work of nurses and their role in the origin of medical error. Human factors engineering (HFE) has been used widely to improve the operation of complex systems, reduce cognitive errors related to poor human-computer interfaces, and increase the comfort level of workers. However, because the work of nursing is self-paced, discretionary, and nonlinear, HFE has been unsuccessful in analyzing knowledge and service work of nursing practice (Pepitone, 2002).

Potter et al (2005) explored the nature of the clinical decision-making process of nurses in practice via qualitative observation, along with HFE techniques (task analysis), produced a cognitive pathway. The results were taken from observations of three RNs. A human factors engineer and a nurse-researcher jointly and simultaneously observed the RNs during the first 8-10 hours of their routine 12-hour day shift. The nurse-researcher conducted a qualitative analysis with the focus of understanding the activities of patient care within the context of the nursing process. The settings were comprised of a general acute medicine unit and a neuro-medicine unit. The RNs averaged 13.4 years of experience. Registered nurses averaged 30 interruptions per shift. Forty-seven percent of the interruptions occurred during the intervention step of the nursing process. The task analysis showed a high proportion of nursing activity being spent on patient contact and communication. The findings in this study showed that attention should not only focus on task-related processes of patient care, but also on the impact of the work environment on clinical decision-making. Therefore, systems implemented without considering

environmental variables that may interfere with instead of enhance nurse work might add to the nurses' dissatisfaction.

### *Introducing and Making Sense of Technological Innovation*

The introduction of IT into nurses' work has proven more difficult to adapt to clinical practices than initially expected. In fact, many systems have been designed, implemented and rolled out only to fail. These system failures often result from a lack of fit with nursing activities and required work-a-rounds in order to complete work procedures (Jensen & Aanestad, 2007). Failures such as these could be alleviated with the involvement of nurses in the selection, design, implementation, and periodic assessment of the operation of these systems and a more complete understanding of the work environment. As noted previously, the system must make "sense" to its users. The idea of making sense has made its way across a variety of settings including libraries, media systems, web sites, public information campaigns, classrooms, and counseling services (Dervin, 1999). From an IS perspective, Solomon explored the role of information in people's work lives, by using the methods of ethnography of communication to explore the time aspects of the work-planning tasks (1997a), along with the social aspect (1997b), and the individual aspect (1997c) of information behavior in sense making of participants in the annual work planning of a unit of a public agency.

Solomon found that the participants in this three part study viewed "information behavior as intrinsic to a process, which they labeled as sense making, and that this process unfolds over time, is structured by the norms and resources (culture) of the organization and by the devices of communicative events" (Solomon, 1997c; p. 1137). Moreover, the social aspect in sense making and the way people develop meaning is

influenced by their sense making styles. These styles include: cognitive, affective, and conative (action instinct). According to Solomon (1997), these styles seem to be influenced by the person's role in the organization and the work planning task.

*Cognition* describes how people develop an appreciation of an object in a way that builds on their previous knowledge and experience, cognitive apparatus, and the task and other aspects of the situation. The *Affective* sense making style describes the expressions of emotions, feelings, temperament, mood, and the like as it relates to the work planning process and how these affective styles seem to mitigate or amplify sense making behavior. Finally, the *Conative* style encompasses the people's resistance or acceptance to change. The study participants' were at times “motivated to insist upon some actions to the extent that they would follow their instincts even when faced with widespread resistance” (Solomon, 1997c; p. 1137). Furthermore, Solomon goes on to state, “Grounding designs in an understanding of variety, uncertainty, and complexity of the role of information in people's lives is a way to bridge the gap between people and information systems, information specialists, and information institutions.

Jensen & Aanestad (2007) analyzed the healthcare professionals' conceptions of an EPR, how this technology relates to their professional roles, and aspects of the implementation process from a “sense-making” perspective. Using an interpretive case-study design, researchers chose two units in two different hospitals: a cardio-thoracic surgery ward and orthopedic surgery ward. These units were selected because both had recently implemented an EPR. Although both settings were not similar, both resembled one another by comparable specialties (surgery), the system, the project management approach, and time frame of the adoption. Researches found that sense-making is an

active process that reflects the way healthcare professionals talk about the adoption, and how they enact the technology. Also, they noted that the environment in which the EPR evolves cannot be considered as singular and fixed.

Sense making during adoption is illustrated in the literature (Prasad, 1993). Prasad examined symbolic processes during implementation of technological innovation. This researcher found that the symbolism of computerization held by healthcare workers within a healthcare organization changed as the computerization effort progressed from pre-computerization, through training and implementation, into the “adoption” phase of the process. For example, nurses initially viewed the computerization process with such terms as professionalism, inevitability, turmoil and utopianism. As computerization progressed into implementation, the turmoil and utopianism symbols were no longer used, but a new term, “otherness” emerged. Some perceptions were dropped and replaced by other perceptions. Astonishingly, the fact that mental frameworks were in place from the beginning and continued well after initial adoption as individuals who used the system were attributed increased social status within the organization. Adoption itself does not take place as a single decision, but rather as a series of sensemaking cycles causing perceptions of the technology to change until apparent adoption or rejection actions are performed (Seligman, 2006).

#### *Nurse Perceptions Related to Implementation*

As previously stated, a negative perception of a new system can lead to unintentional documentation and/or patient care errors. Additionally, implementation of a system could be perceived unfavorably if it does not live up to the expectations of its users. It is shown in the literature that the implementation of a clinical information

system may decrease time spent during documentation (Bosman, Rood, Oudemans van Straaten, Van der Spoel, Wester & Zandstra, 2003; Minda & Brundage, 1994), increase time in direct patient care (Pabst, Scherubel & Minnick, 1996; Wong, Gallegos, Weinger, Clack, Slagle & Anderson, 2003), increase work excitement among users (Ngin, et al., 1993), be perceived favorably (Dennis et al., 1993), and be viewed as a much-needed solution to minimize medical mistakes (IOM, 2001; Leape & Berwick, 2005; Wachter, 2004). However, nurses with limited input, as well as nurses with negative experiences with past implementations would most likely reject rather than enact new technologies.

Nurses spend an estimated 30% of their time documenting patient care (Miller & Arquiza, 1999). Therefore, perceptions of a system that would save time documenting patient care while increasing nurses' time in direct care could play a role in creating a positive perception of the new innovation by nurses. Researchers (Pabst, et al., 1996; Wong, et al., 2003) reported an increase in direct patient care. In Pabst et al (1996), two nursing units (unit A & B) were used in this study. A comparison of documentation time was used after the implementation of a computerized documentation system on unit A. Prior to implementation, unit A's staff spent 13.7% of their time charting. Three months post-implementation, this time was decreased to 10.8%. Six months later, charting time decreased even more to 9.1%. The authors illustrated a time savings of 20 minutes with the use of the automated system by unit A in comparison to the non-automated, unit B.

Wong et al (2003) showed an increase in direct patient care ( $31.3 \pm 9.2\%$  to  $40.1 \pm 11.7\%$ ,  $p=.085$ ) after the installation of a third-generation clinical information system. Using a time-motion analysis method, researchers found that the system decreased time spent during documentation ( $35.1 \pm 8.3\%$  to  $24.2 \pm 7.6\%$ ,  $p= 0.025$ ) by 31%. The

documentation data revealed a savings of 52 minutes per 8-hour shift worked, using the system. Also, the number of patient assessment (a direct care activity) occurrences increased indicating more time spent in patient care. Completeness and legibility of this system's documentation was not shown in this study. The installation of computerized documentation should not only decrease time spent documenting, but also decrease liability of litigation through legible and complete documentation.

The impact of a computerized system on nurse perceptions and work satisfaction by nursing staff is evident in several studies (Dennis et al., 1993; Ngin, et al., 1993). The participants in Dennis et al. (1993) perceived the total system significantly more favorably ( $p < .05$ ), and the users were significantly more satisfied ( $p < .01$ ) with the product than initially anticipated. Ngin, et al (1993) showed significant findings in work excitement among novice and expert users. Nurses who classify themselves as expert users had significantly higher levels of work excitement than nurses who were novices, or had no experience with the computer. Those nurses with intermediate skills also had significantly higher levels of work excitement than novices, or non users. Moreover, computer users were found to be significantly less negative about their work. In addition, nurses considered the computer a nursing technology capable of making their work easier.

### *Human Factors*

There is an increase demand for the utilization of IT in healthcare to support clinicians' work while improving patient safety. However, transforming the healthcare system requires much more than implementing new information systems or providing new computerized tools for clinicians (Ball & Douglas, 2002). Ball & Douglas (2002)

goes on to state that “Technology offers challenging capabilities, not solutions. New evidence and new tools demand new approaches and attention to human factors.” As stated previously, clinical information systems are implemented with limited input from nurses who provide direct patient care (Ball & Bierstock, 2007; Ballard, 2006), and without considering human factors in the systems design and implementation process. Rogers et al (2005) adds that the success of CISs is dependent upon their effective integration into complex work systems involving distributed responsibility and decision-making.

Using scenario-based usability testing methods, Rogers et al (2005) investigated the point-of-care technology, bar coded medication administration (BMA) and wireless medication administration (WMA). Researchers were able to identify new paths to failures from scenario-based testing. This method of testing also identified workplace performance trade-offs related to time and production pressures.

Another aspect overlooked in systems design is the application of ergonomics to nurse computer work stations. The Occupational Safety and Health Administration (OSHA) defined ergonomics as the practice of designing equipment and work tasks to conform to the capability of the worker (2002). Although there are a plethora of benefits to using computers in nurses' work settings, the incorporation of ergonomic factors into work settings promote safe workplace environments (Neilsen & Trinkoff, 2003).

According to the Bureau of Labor Statistics (BLS) (1999), nurses are more at risk than construction laborers to sustain work-related musculoskeletal disorders (MSDs). In fact, RNs in the U.S. suffered from over 13,000 nonfatal occupational MSDs requiring days away from work, 23% involving the upper extremity (BLS, 1999). The use of

computers at home as well as at work has also resulted in higher incidence of related cumulative trauma disorders (CTDs) experienced by nurses (Zecevic, Miller, & Harburn, 2000). CTDs are the most frequently occurring injury associated with computer use. Because tasks such as charting and entering patient orders require more time working at the computer, nurses are more prone to these work related injuries (Nielsen & Trinkoff, 2003).

Nielsen & Trinkoff (2003) examined the literature pertaining to computer workstation ergonomics, related ergonomic standard policies from OSHA and the National Institute of Occupational Safety and Health (NIOSH), and posed recommendations for employers as it pertains to ergonomic programs. The literature examined comes from professional nursing management, research, occupational health, ergonomics, and informatics journal articles. The Bureau of Labor Statistics and OSHA websites and publications about ergonomic guidelines and policies were explored. Studies illustrated a positive relationship between improved workstation design and physical safety and productivity of the combined human-computer system. However, researchers contend that more work must be done to address nurse-computer interactions. Until then, researchers recommend that workstation and worker assessments be done before purchasing computer station equipment.

The effectiveness of any ergonomic interventions can be evaluated by comparing staff injury rates and job turnover and absenteeism rates to those before the program was instituted (NIOSH, 1997). However, redesign initiatives are often undertaken by interdisciplinary teams without the use of professional experts in work design (IOM, 2004). There has been much debate pertaining to the role of the ergonomist in the area of

human factors and ergonomics. Drury (1995) argues that “there is no substitute for the ergonomist's knowledge and understanding of both the system under study and the ergonomics literature (p. 66-67). In contrast, Gosbee (2002) asserts that “human factors engineering must become a core competency of anyone who has significant involvement in patient safety activities.” (p. 354). Corlett (1991) states that “ergonomics should be given away....transfer our knowledge and methods to others who are closer to the places where changes have to be made, so that they do much of the ergonomics for themselves....Until ergonomics is widely practiced by other than professional ergonomists, it is likely to remain something to be added on at the end” (p. 418).

#### *Nurses as Knowledge Workers*

Healthcare organizations are recognized as one of the most knowledge-intensive environments (Drucker, 2001; Snyder-Halpern, et al., 2001, Sorrell-Jones & Weaver, 1999). However, despite this recognition, these organizations have been slow to making a shift from an Industrial Age organization model to a service-oriented model which is more applicable for knowledge-intensive environments (Snyder-Halpern, et al., 2001; DeLong & Fahey, 2000). Because of this lag, many organizations have implemented programs to better manage knowledge. Chief Knowledge Officer and Knowledge Manager are titles now seen in organizations to create, organize, and use knowledge to give organizations a competitive edge. However, according to DeLong & Fahey (2000), the efforts of many companies to manage knowledge have not achieved their goals, and there is a sense of disenchantment among executives about the practicality of trying to leverage organizational knowledge to a strategic advantage. In healthcare organizations, clinical practice environments are more likened to assembly-line manufacturing processes

than the knowledge work of its workers. Furthermore, “some hospitals have mastered interdisciplinary communication by making contribution an ingrained habit while others did not, despite efforts to communicate and coordinate through committees, staff conferences, bulletins, sermons, and the like.” (Drucker, 2001; p. 215).

Nurses are the largest group of knowledge workers (Snyder-Halpern, et al., 2001). A knowledge worker is someone who relies on knowledge rather than skills to perform a job (Drucker, 1999). Moreover, Drucker touted that a large number of knowledge workers do both knowledge work and manual work, terming these types of workers as “technologists”. Nurses, as well as many other health professionals are covered in this definition. In addition, today’s knowledge workers are part of a workforce that is significantly different than those of the past, when manual work was clear and well defined (Covey, 2003). As healthcare organizations become more knowledge-intensive, nurses are challenged to effectively manage and use technological innovation to support their practice. Nurses assume many roles that require constant decision-making. These roles entail the “tasks associated with human information processing in which the dominant activities include data gathering, information use, the creative application of domain knowledge to clinical practice, and the generation of new knowledge” (Snyder-Halpern, et al., 2001; p. 18).

### *Summary*

Health care organizations are characterized by rapid scientific and technological advances. In fact, IOM (2001) cites these advances in health care knowledge, drugs, medical devices, and technologies as one of four defining attributes of the U.S. Health system. As stated previously, to capitalize on the power of these technologies, the largest

group of CIS users, nurses, must have unlimited input in the selection and design of these systems as well as input at each stage of the systems life cycle in order to mitigate implementation failures and enhance their work environment. Also, nurses must be supported by environments with an in depth understanding of their roles as they carry out their complex knowledge work. In addition to understanding nurses' roles, healthcare organizations must provide decision support processes that match knowledge-worker roles. Therefore, employing ways to optimize their ways of knowing without compromising patient care quality would support positive nurse outcomes.

## CHAPTER 4

### Argument

The implementation of clinical information systems has been found to the decrease time spent documenting (Bosman, et al., 2003; Minda & Brundage, 1994), increase time in direct patient care (Pabst, et al., 1996; Wong, et al., 2003), increase work excitement among users (Ngin, et al., 1993), be perceived favorably (Dennis et al., 1993), and be viewed as a much-needed solution to minimize medical mistakes (IOM, 2001; Leape & Berwick, 2005; Wachter, 2004).

While clinical information systems are deemed as a necessary technological tool for improving patient safety, the possibility of creating new errors is highly likely if the work of nurses, and specifically, the human interaction component of systems, is not supported at the point of care delivery by the health organization (IOM, 2004; Reason, 1990).

Nurses are typically the largest user group of hospital information systems (Hilz, 2000; Lee, 2004). Therefore, nurses are key stakeholders and can greatly impact the user acceptance of a new clinical information system. However, nurses have limited input in CIS implementation, which places further demands on this valued worker. Furthermore, the design of their work processes and workspaces are often flawed and contribute to threats to patient safety and staff safety and wellbeing (Hyman, 1994; IOM, 2004; Senders, 1994).

Tucker & Edmondson (2002) found that failures in the design or execution of hospital work processes were so common that they were considered routine. This “routine” can simply exacerbate operational failures by continuing to repeat bad processes (Tucker, 2004; Tucker & Edmondson, 2003). Particularly problematic is that these failures are not shared so that employees continue to individually develop work-arounds independently. As a result, the operational failure continues unabated and the solutions are not consistent across professionals engaging in the work (Halbesleben & Rathert, 2008). So far, the discussion has focused on the literature and results of one case example. The following sections will detail a summary of key points will set the stage for outlining implications of this understanding for individual nurses, the nursing profession, and health care organizations.

## CHAPTER 5

### Discussion

#### *Implications for Nursing (Academia, Research, Clinical Practice)*

Health leaders from various disciplines are committed to ensuring health professionals, particularly nurses, are equipped with tools necessary to best perform and support the activities of nurses as knowledge workers thus improving their environment. Besides the rapid introduction of clinical information systems into nurses' work flow, and their limited input in its selection, design, and system implementation a particular problem affecting nursing and health care systems is the growing nursing shortage. The nursing shortage is huge burden to health care organizations because care quality is a function of its quantity (Simpson, 2007). This premise is supported by research by Aiken et al (2002), which shows that reduced nursing staffing is associated with longer hospital stays and increased morbidity and mortality. The HRSA projected that the nursing shortage will exceed 1 million nurses by 2010 (ACCN, 2006). Therefore, health care organizations must optimize the existing nursing workforce to ensure quality patient care amid shortages.

Technology has been touted to aid clinicians in making clinical decisions. *Crossing the Quality Chasm* highlights the potential of technology—software that integrates information on the characteristics of individual patients with a computerized knowledge base for the purpose of generating patient-specific assessments or recommendations designed to aid clinicians in making clinical decisions. However,

these systems are often implemented and evaluated with respect to physician practice, hospital operations and ancillary departments (i.e. laboratory, radiology, etc) rather than nursing (Ball & Bierstock, 2007; IOM, 2004). Moreover, there's a discrepancy between new technologies deployment and the integration into nursing basic education of the skills needed to support nurses' work. Although, nursing informatics (NI) has been recognized as a specialty since 1992 by the American Nursing Association, fewer than 50% of accredited nursing schools offered graduate or undergraduate programs with NI specific courses (National Advisory Council on Nurse Education and Practice [NACNEP], 1997). NACNEP further purports, of those schools who did offered NI courses, some only covered basic computer literacy, without nursing-specific NI courses.

Nursing informatics is “a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice” (ANA, 2007). This specialty supports patients, nurses, and other providers in their decision-making in all roles and settings. ANA go on to state that this support is accomplished through the use of information structures, information processes, and IT. According to Windsor (2006), few differences exist in the goals of nursing and nursing informatics. Nursing informatics exists to support the highest possible quality of care, and the core service of nursing is patient care (Turner, 2002). However, informatics belongs to the specialists (Hebert, 2000). Furthermore, because of the rapid introduction of clinical information systems into nurses' work, many stakeholders are being faced with a need to define informatics competencies for nurses.

Informatics knowledge and skills range from how to use a clinical application or knowledge about basic technology terms to more advanced concepts surrounding nursing structured languages (i.e., NANDA, NIC, NOC) or evaluating the impact of a clinical system on practice (Staggers et al, 2002). Because there is a lack of informatics knowledge and skills among nurses as well as other health professionals in work settings (Barnett, 1995; Carter & Axford, 1993; Ngin & Simms, 1996; Staggers, et al., 2002; Staggers, Gassert, & Skiba, 2000), and in academia (AACN, 1997; McCannon & O'Neal, 2003; Smith, 2006; Staggers et al, 2002; Staggers et al, 2000), healthcare leaders must address this discrepancy through needs assessment prior to and during implementation, at job entry, and in nursing education programs (ANA, 2007).

The American Association of Colleges of Nursing (AACN) introduced guidelines pertaining to nurses' education and information technologies role in health care, while AMIA examined informatics education by all health professionals (Staggers et al, 2000). Both organizations contend that there is a need for research-based, informatics competencies to guide curricular development in formal academia. Staggers et al (2002) created and validate a research-based master list of informatics competencies for nurses by differentiating these competencies across all levels of practice. An expert panel was formed to define initial competencies for each level of nursing. These definitions for levels of nurses include: beginning nurses (level 1), experienced nurses (level 2), informatics specialists (level 3), and informatics innovators (level 4).

Beginning nurses (Level 1) have fundamental information management and computer technology skills and use existing information systems and available information to manage their practice. Experienced nurses (Level 2) have proficiency in

their domain of interest (e.g., public health, education, administration). These nurses are highly skilled in using information management and computer technology skills to support their major area of practice. They see relationships among data elements, and make judgments based on trends and patterns within these data.

Informatics specialists (Level 3) are registered nurses who possess additional knowledge and skills specific to information management and computer technology. They focus on information needs for the practice of nursing, which includes education, administration, research and clinical practice. In their practice, informatics specialists use the tools of critical thinking, process skills, data management skills (includes identifying, acquiring, preserving, retrieving, aggregating, analyzing, and transmitting data), systems development life cycle, and computer skills. Informatics innovators (Level 4) are educationally prepared to conduct informatics research and to generate informatics theory. Innovators function with an ongoing healthy skepticism of existing data management practices and are creative in developing solutions. Innovators possess a sophisticated level of understanding and skills in information management and computer technology. They understand the interdependence of systems, disciplines, and outcomes, and can finesse situations to maximize outcomes.

The Robert Wood Johnson Foundation funded the Quality and Safety Education for Nurses (QSEN) project to prepare future nurses with the knowledge, skills and attitudes to improve the quality and safety of health care systems in which they will work. This project, spearheaded by Dr. Linda Cronenwett, Dean and Professor at the University of North Carolina at Chapel Hill, is supported by a national core faculty and advisory board (Smith, 2006). Phase one (1) of this project has built and expanded upon IOM's

(2003) recommendations to “identify and define” six core competencies for incorporation into pre-licensure nursing students' curricula. These core competencies include: patient-centered care, evidence-based practice, teamwork and collaboration, safety, quality improvement, and informatics.

A national electronic survey was administered by the QSEN staff to selected associate degree in nursing and Bachelor of Science in nursing programs to determine the state of nursing curricula. Pedagogical strategies were developed by QSEN to help convey these competencies into curricula and practice (Cronenwett et al., 2007). In the following year, QSEN was funded for phase two (2), which was expanded to include advanced practice students and clinicians. The QSEN collaborative could be useful for understanding staff nurse informatics needs as well as needs of those entering the profession.

The Technology Informatics Guiding Educational Reform (TIGER) is working to “enable practicing nurses and nursing students to fully engage in the unfolding of the digital electronic era in healthcare” (TIGER, 2006). The purpose of this initiative is to identify information/knowledge management best practices and effective technology capabilities for nurses. TIGER’s platform, like QSEN, is built on the Institute of Medicine’s premise in *Health Professions Education: A Bridge to Quality* (2003) that incorporating informatics into health care practice is a core competency for all health professionals.

#### *Implications for health care organizations*

Hopefully, this discussion will provide guidance to health care organizations and professionals struggling to keep pace with the rapid introduction of clinical information

systems into nurses' work environment. "Successful organizations must foster innovation and master the art of change or they'll become candidates for extinction" (Robbins, 2005; p. 23). Fostering change requires empowering employees by placing them in charge of what they do (i.e., shared governance, magnet designation). According to Robbins (2005), the only way this can be accomplished is by relinquishing control by executives, so that employees can learn to take responsibility for their work and make appropriate decisions. The lack of control over nursing practice or inability to make decisions based on one's knowledge because of a system based on rigid hierarchical rules has been shown in the literature as one of many reasons for nurse dissatisfaction.

Magnet designation is shown in the literature to positively enhance the nursing practice environment (Friese, 2005). In fact, Magnet hospitals were identified as being more successful in attracting and retaining nurses in comparison to non-magnet hospitals (Aiken & Patrician, 2000). Autonomy and control over nursing practice (Havens & Aiken, 1999), good relationships with physicians, flexible scheduling, strong nursing leadership, participative management, and professional development (Stovie, 1984), are cited as the characteristics of a practice environment in Magnet organizations. McClure, Poulin, Stovie & Wandelt (1983) found that Magnet hospitals had low nursing turnover rates even during times of nursing shortage.

Along with magnet designation to enhance the nursing practice environment, promote professional development and improve nurse satisfaction, healthcare organizations must seek to strengthen ongoing assistance in knowledge and skill acquisition. The overwhelming expansion of clinical knowledge, medications, medical equipment, and new technologies continues unabated (IOM, 2004), and likely provides

ongoing benefits to patients (Bates et. al., 2001). However, with this rapid expansion of knowledge come risks to patient safety. “Today, no one clinician can retain all the information necessary for sound, evidence-based practice; no unaided human being can read, recall, and act effectively on the volume of clinically relevant scientific literature” (IOM, 2001a: p. 25). IOM's premise has implications for the work environment of nurses and patient safety. Therefore, health care organizations must seek to improve patient safety as well as satisfaction of nurses by assessing the culture of the nursing organization and transforming it into one of a “learning organization” (Holden, 2006; IOM, 2004).

A learning organization is an organization “skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insight” (Garvin, 1993: p. 80), and allowing its workers “slack” to “unleash their genius, reinvent health care, and fix health care from the inside out” (Kerfoot, 2007; p. 61).

Senge, Kleiner, Roberts, Ross & Smith (1994) described the components of a learning organization as: systems thinking, personal mastery, mental models, team learning and shared vision. Systems thinking require the entire organization, not just the nursing department, to support and embrace change. The entire organization must be able to see that each part of the system has an effect on the whole. Personal mastery involves the development of the person as a constantly evolving and improving individual and professional. Benner's (1984) stages in describing the professional evolution of a nurse (novice, advanced beginner, competent, proficient, and expert) would be a prime example of personal mastery.

As new technology evolves and the entire profession develops, even the expert can become a novice with respect to a new procedure or skill (Holden, 2006). Mental

models encourage abstract thinking in order to make sense of the organization, the nursing unit, or the problem by framing it and then re-framing the situation to improve or redirect efforts. “Mental models, combined with the respect for individual and professional opinion, encourage input to improve the organization as a whole.” (Holden, 2006; p. 36). Team learning represents not only the ability of a unit to move forward as a unit but also suspending the paradigm of “us versus them” to a “we” paradigm throughout the organization. Shared vision is a collective moving of an entire group towards a joint goal.

Creating a learning organization is without its challenges. DeLong & Fahey (2000) found that organizational culture was an impediment to creating a learning organization. In order to create a learning environment, IOM (2003) recommends that health care organizations should assess existing knowledge culture within an organization; freeing up employee time for thinking, learning, and training; and aligning incentives to reinforce and facilitate uptake of knowledge management practices. Moreover, adapting to people who are different is another challenge facing health care organizations.

In Robbins's *Organizational Behavior*, the term used to describe this challenge is workforce diversity. Workforce diversity means that “organizations are becoming a more heterogeneous mix of people in terms of gender, age, race, ethnicity, and sexual orientation.” (p. 17). Traditionally, it has been assumed that people who are different would automatically want to assimilate into an organization. However, it has been shown that employees do not easily relinquish their cultural values, lifestyle preferences, and differences when they come to work. Therefore, recognizing value differences is vital to

embracing diversity thereby improving quality and productivity especially during shortages.

*Recommendations for future research*

This paper demonstrates a need for nurse researchers and health leaders to examine all facets of nurses' work environment from the introduction of clinical information systems to their decision-making when selecting, designing, and implementing these systems. Nurses must view these systems favorably. As stated previously, a negative perception of a new system can lead to unintentional documentation and/or patient care errors through work-a-rounds or worse, system abandonment (Englehardt & Nelson, 2002). In essence, these systems must “make sense” to nurses, as well as be a fit into their practice. In addition, nurses must be involved at every level of a system's life cycle. Moreover, human factors associated with system implementation must not be overlooked nor saved for last. Human factors include usability, ergonomics, scenario-based testing, and other strategies to truly support the practice environment. Healthcare organizations are knowledge driven environments. Therefore, nurses must be proficient and competent to effectively manage large amounts of data to support their practice.

The conceptualization of nurse readiness (NIRM), in particular its knowledge sub-component could assess the need for further training and communicative initiatives to expand on the benefits of technological innovations into their environment. The NIRS is still an incipient assessment tool and needs to be further developed through future studies. Further enhancements and validation efforts of nurse readiness assessment tools will allow nursing leaders to effectively assess and identify issues related to technology

implementation. Over 50% of CIS implementations fail. Therefore, research examining whether the assessment of informatics competencies and user acceptance of CIS by nurses in work settings could possibly decrease implementation failures. Moreover, the creation, then testing of research-based competencies in nursing could ensure the use of IT to its full potential by equipping these users with the knowledge, skills, attitudes and informatics competencies needed to support safe patient care.

Future studies may combine survey methodology with structured interviews or conduct a Delphi study with a panel of experts to validate surveys. A mixed-mode survey that uses the Internet and paper may also help the response rate. However, proven methods found to improve response rates are frequent visits or reminders from researchers. The survey could also be replicated in multiple environments and at multiple phases within the SDLC. Longitudinal studies over time would be helpful to compare survey results at different points throughout the SDLC. For instance, survey results may change after a new technological system has been fully implemented and results may vary according to elements of successful or failed implementation.

In addition to longitudinal studies, scenario-based testing could aid health care leaders to identify new paths to failures. Also, with scenario-based testing, workplace performance trade-offs related to time and production pressures can be identified. “Human-computer interaction (HCI) deficiencies and mismatches between systems design and the structure of work create the potential for new paths to system failures” (Rogers et. al., 2005: p. 365). Therefore, this methodology may impact human performance thereby improving patient safety.

Multidisciplinary focus in clinical information systems (CIS) implementation is shown in the literature (Hilz, 2000; Staggers et al, 2000). However, as “new systems affect larger, more heterogeneous groups of people and more organizational areas, the major challenges to systems success often become more behavioral than technical” (Lorenzi & Riley, 2000: p. 116). Specialists in the area of organizational behavior and human factors engineering could “reconsider how work would be done and an organization structured if it were starting over in the approach called process reengineering.” (Robbins; p. 20). The term reengineering comes from the process of taking apart an electronic product and designing a better version. In organizations, process reengineering entails rethinking and redesigning the processes by which the organization creates value and does work, ridding itself of operations that have become antiquated (Hammer & Champy, 1993). The extensive literature within this paper shows that nurses are not really viewed as end users in CIS implementations. Therefore, it will take leaders in all facets of healthcare, especially nurses to alter this misperception to mitigate system failures.

## CHAPTER 6

### Conclusion

This discussion serves to validate evidence that the nurse is not really viewed as an end user in CIS implementations. Moreover, nurses are having difficulty adapting to new technological innovation into their practice (Ballard, 2006; Snyder-Halpern, et al., 2001). This difficulty is often due to not having control over systems being implemented into their work flow, ineffective integration of these systems into their work, and not being properly trained to operate these systems. The need for nurses to be involved at every level of decision-making as it relates to the introduction of innovation into their work is imperative to mitigate system failure and truly support nurses' work.

Health care organizations will continue to be faced with challenges such as fluctuations in nurse staffing which could result in high cost of turnover, higher acuity of patients, efforts to decrease medical errors and the need to implement new technologies. The inevitable change that occurs with implementation of new technologies is becoming a constant variable within the culture of nursing. Nurses and health care leaders need to be aware of the internal and external factors that impact the context of nursing, including the impact of technology into nurses' work. In order to create a sustainable environment primed for change management and better working conditions for nurses thereby possibly ensuring better patient outcomes, healthcare organizations must allow nurses unlimited access to system planning and design. Human factors associated with implementation should not be ignored. Otherwise, we will continue to be confronted with the statistics of

over 50% of CIS implementations failing. Therefore, truly supporting and strengthening nurses' acquisition of knowledge would improve their practice environment.

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