The Relationship of Nursing Intellectual Capital to the Quality of Patient Care and the Recruitment and Retention of Registered Nurses

by

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Faculty of Nursing
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Abstract

To ensure quality patient care hospitals invest in nursing intellectual capital by allocating financial, human and material resources for nurses to acquire the knowledge and skills necessary to provide safe patient care. This study’s purpose was to test selected propositions of the middle-range theory of nursing intellectual capital which provides a conceptualization of the influence of nurses’ knowledge, skills and experience (nursing human capital) to patient and organizational outcomes. The theory was systematically developed after a critical review of the literature. It proposes that nursing human capital (registered nurses’ experience, and knowledge and skills acquired from continuing professional development including university courses, conferences, workshops, in-services, specialty certification) is related to variables within the work environment (nurse staffing, employer support for nurse continuing professional development), which in turn, is associated with the quality of patient care (adverse events) and the recruitment and retention of nurses. The theory also proposes that
nursing structural capital, nursing knowledge available within practice guidelines, is associated with the quality of patient care. A cross-sectional design was used to test the proposed relationships. The study took place in 6 acute care hospitals in two provinces of Canada. Financial, human resource and risk management data were collected from hospital departmental databases and a survey of unit managers. Data from 91 inpatient units were used with structural equation modeling to test the theory’s propositions. The results indicated that nurses’ knowledge and skills represented by the proportion of RNs with degrees and proportion of RNs with specialty certification were directly associated with low hospital-acquired infection rates. Nurse experience, measured as mean years RN professional experience and RN unit tenure, was found to be significantly related to higher RN recruitment and retention. The proportion of RNs with degrees was found to partially mediate the influence of nurse staffing on hospital-acquired infections. The results provide preliminary evidence of the association of nursing intellectual capital with patient and organizational outcomes. The findings may assist administrators with fiscal and human resource decision-making related to the education of nurses within acute care hospitals, and professional organizations with policies governing nursing education and continuing professional development.
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Chapter 1
Introduction

Hospitals invest in nursing human capital, the knowledge, skills and experience of nurses, by
providing resources in the form of continuing professional development (CPD) to encourage
nurses to develop their knowledge and skills, ensure good quality patient care, retain a
competent workforce and recruit nurses (Nolan, Owens, Curran, & Venables, 2000;
Upenieks, 2003a). In addition, professional organizations require nurses to participate in
CPD on the supposition that it develops their knowledge and skills, assists them with
maintaining professional competency and protects the public from unsafe care (Canadian
Nurses Association [CNA], 1998; Canadian Nurses Association [CNA] & Canadian
Association of Schools of Nursing [CASN], 2000). Nurses believe participating in CPD
increases their knowledge and skills, ensures that they remain clinically competent and is
essential for the provision of good quality patient care (Hughes, 2005). Nurses are attracted
to organizations that support the development of their knowledge and skills (Upenieks,
2002). However, there is limited empirical evidence that nurse participation in CPD increases
nurses’ knowledge and skills, maintains competency, improves the quality of patient care or
promotes the recruitment and retention of nurses within hospitals. In addition, there is little
known about how the work environment influences the development of nursing human
capital (registered nurses’ experience, and knowledge and skills acquired from CPD) and the
application of knowledge and skills nurses acquire from CPD. Without empirical evidence
describing the influence of nursing human capital to the quality of patient care and the
recruitment and retention of nurses it remains uncertain if investing in nursing human capital
is beneficial to patients or organizations.

The lack of empirical evidence to support the development of nursing human capital through
nurse participation in CPD may lead to administrative decisions which further reduce or
eliminate educational resources and opportunities for nurses to develop their human capital.
With limited opportunities to develop their human capital, nurses may not acquire the
necessary information required to make the complex decisions needed to provide good
quality and safe patient care. In addition, if nurses are unable to develop their human capital
(knowledge and skills), they could become dissatisfied with their jobs and resign (Chandra,
This can result in an increase in nurse turnover and thus higher costs related to the orientation and training required for the development of newly hired nurses’ human capital.

The focus of this study was on examining the contribution of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) to the quality of patient care and organizational outcomes related to the recruitment and retention of nurses. By utilizing a middle-range theory derived from the theory of intellectual capital, this study aimed to explain under what conditions nursing human capital affects the quality of patient care and the recruitment and retention of RNs within acute care hospitals. Developing a better understanding of how nursing human capital is associated with patient and organizational outcomes provides administrators with evidence to guide their decision-making related to the allocation of budgets and the management of human resources for the CPD of nurses.

**Background**

This section reviews the (a) factors contributing to the need to examine the relationship of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) to quality of patient care and recruitment and retention outcomes, (b) models that have guided evaluation of CPD, and (c) characteristics of the work environment that could influence the impact CPD on outcomes.

**Factors contributing to the need to examine the relationship of nursing human capital to outcomes.**

Several factors have contributed to the need for a better understanding of the relationship of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) to the quality of patient care and nurse recruitment and retention. They include (a) rising health care costs, (b) advances in technology, (c) recent legislation, and (d) the lack of empirical evidence related to the impact of CPD on the quality of patient care and nurse recruitment and retention.

**Rising health care costs.**

Despite the numerous cost saving strategies imposed by provincial governments in the mid to late 1990’s, the cost of health care in Canada continues to rise with hospitals accounting for
approximately 30% of the country’s annual health care expenditures (Canadian Institute for Health Information [CIHI], 2006a). The strategies employed to save costs included the reduction in hospital operating budgets, early retirement packages, hospital closures, mergers and organizational restructuring (O’Brien-Pallas, Tomblin Murphy, Laschinger, White, & Milburn, 2004). These strategies resulted in the loss of nurses with high human capital (knowledge, skills and experience) thus limiting the clinical decision-making support for junior nurses (Baumann et al., 2001; O’Brien-Pallas et al., 2004; Canadian Nurses Advisory Committee [CNAC], 2002; Laschinger, Almost, & Tuer-Hodes, 2003). Without access to expert nurses (with high human capital) to assist them with their decision-making, nurses may not be acquiring the human capital (knowledge, skills and experience) necessary to form appropriate clinical decisions, which can result in the provision of unsafe or poor quality patient care.

Governments also placed demands on hospitals to function more effectively and efficiently by requiring them to maintain a balanced budget. As a result, hospitals were forced to reallocate their budgets often reducing funding for nursing services (Baumann et al., 2001; CNAC, 2002). One way some nursing administrators responded to the reduction in funding was by decreasing or eliminating nurse CPD activities and educational resources such as clinical nurse educators, time away from the bedside to learn, and financial support for nurses to attend conferences or university courses (Baumann et al.; CNAC). However, these budgetary decisions were not based on empirical evidence but rather on what nurse administrators “thought” would promote quality patient care considering cost constraints (O’Brien-Pallas et al., 2004). This method of decision-making is not surprising since there is limited empirical evidence related to the impact of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) on the quality of patient care. Without empirical evidence to guide their decision-making administrators may have made financial decisions that resulted in limited opportunities for nurses to develop the human capital (knowledge, skills and experience) necessary to provide competent and safe care.

**Advances in technology.**

In today’s highly complex and technologically advanced environment, the elimination of educational resources in combination with the reduction in clinical decision-making support
for nurses is concerning for advances in technology alone have presented a greater need for CPD after nurses enter the profession (Advisory Committee on Health Human Resources [ACHHR], 2000). Wang, Nagle, Li, and Wu (2004) investigating the effects of technological change as a part of the Nursing Sector Study in Canada found that where employers supported CPD, nurses were more likely to receive adequate training in technology. Training in technology enhanced the nurses’ use of the technology, increased their level of confidence, improved their appreciation related to the efficiency that the technology brought to their work, and their perceptions of the quality of patient care (Wang et al.). Furthermore, the more confident nurses were in using the technologies the more satisfied they were with their jobs (Wang et al.). Not providing nurses with CPD after they enter the profession could result in nurses lacking the necessary human capital (knowledge, skills and experience) required to use the technology correctly which could put patient safety at risk, or negatively influence nurses’ job satisfaction.

**Recent legislation.**

The availability of educational resources is also especially important in today’s evolving health care system due to changes in legislation that have resulted in expanding the scope of practice for nurses. Recent legislation in many provinces has permitted RNs to perform techniques and make clinical decisions that were previously performed by medical residents or physicians (Ordre des infirmières et infirmiers du Québec [OIIQ], 2003a; 2003b). The need for CPD is particularly evident in specialty areas (Baumann et al., 2001) where hospitals hire new graduates into areas such as emergency departments, critical care units and operating rooms (Loiseau, Kitchen & Edgar, 2003). An inexperienced nursing workforce in specialty areas is concerning as nurses in these areas are expected to quickly acquire increasingly complex skills, such as the insertion of arterial catheters (Allard, Gélinas & Thibault, 2005; Thibault, 2004) and autonomously make difficult clinical decisions such as triaging patients in emergency rooms under stressful working conditions (OIIQ, 2002). Nurses are not often exposed to these types of clinical situations or able to master complex clinical skills during their basic education. Without the benefit of educational resources and decision-making support from more experienced nurses, junior nurses may not be acquiring the necessary human capital (knowledge, skills and experience) required to practise competently and therefore they may be putting patients’ safety at risk. In addition, stressful
working conditions accompanied with the lack of decision-making support could contribute to nurses becoming dissatisfied with their jobs or resigning from their jobs (Upenieks, 2002; 2003a; 2003b).

Besides decision-making support, nurses also require access to information, resources, and opportunities to learn, in order to be satisfied with their jobs (Laschinger, Fiegan, Shamian, & Wilk, 2003). Nurses have recognized that having access to information in the form of practice guidelines, care maps and protocols as being instrumental for increasing their knowledge. Further, the same nurses found that patients benefited from their use of the practice guidelines by receiving higher quality of care (Ring, Malcolm, Coull, Murphy-Black & Watterson, 2005).

Hospitals lacking sufficient training, ongoing education and information for nurses in the workplace, have difficulty recruiting and retaining RNs (Fletcher, Guzley, Barnhill & Philhour, 2004; Sechrist & Lewis, 2004; Upenieks, 2003a). Retaining a competent workforce is important not only for the quality of patient care but also for containing costs; high nurse turnover is costly to hospitals due to the need to recruit and train new nurses (Upenieks). It has been estimated that replacing a nurse will cost a hospital approximately 100% of a registered nurse’s annual salary (Michigan Nurses Association, 2004) or as high as $48,000 US for adult medical-surgical nurse and $64,000 US for a critical care nurse (Nursing Executive Center, 2001).

The effects of employing a workforce with limited human capital (knowledge, skills and experience) on the quality of care, particularly in the specialty areas has not been determined. Although one study found that in a variety of inpatient units, greater nurse experience was significantly associated with a lower number of medication errors and patient falls, it did not find a relationship between the RNs’ academic preparation and the same outcomes (Blegen, Vaughn & Goode., 2001). Further, the researchers did not investigate the influence of education obtained after the nurses entered the profession on quality of care outcomes. Although evidence from other studies (Aiken, Clarke, Cheung, Sloane, & Siber, 2003; Doran, Sidani, Keatings, & Doidge, 2002; Estabrooks, Midodzi, Cummings, Ricker, & Giovannetti, 2005; O'Brien-Pallas et al., 2001; 2002; 2005c; Tourangeau et al., 2007) suggests better patient outcomes may occur when care is provided by nurses with
baccalaureate degrees or higher, it remains unclear how nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) obtained after nurses enter the profession affect the quality of patient care in acute care hospitals.

Nurses also require support from their employers in order to update their knowledge and skills (CNAC, 2002). Nurses need time away from the unit to attend CPD activities and to be replaced when they are away from the unit to learn (CNAC; Hayes, McGrath, & O'Brien-Pallas, 2004; O'Brien-Pallas et al., 2004; Smith, 2004). The need for employer sponsored CPD has been repeatedly identified by nurses as being essential for the development of their human capital (knowledge and skills). Nurses in Canada (CNAC), the United Kingdom (Nolan, et. al, 2000) and the United States of America (Fletcher et al., 2004) agree that employer support is required if they are to continue to learn after they enter the profession. In a survey conducted in California (Fletcher et al.), RNs identified “opportunities for continuing education courses”, “tuition reimbursement for degrees” and “employer-sponsored training programs” as highly desirable in a work environment. During focus group sessions, Canadian nurses listed subsidized professional development as the second highest professional priority, followed by being consulted on patient care and changes in the workplace (Viewpoints Research, 2002 as cited in CNAC, 2002). These needs mirror those reported by nurses in the United Kingdom where 80% of the nurses (n = 100) surveyed identified lack of funding support from employers as a significant barrier that prevents them from updating their knowledge and skills (Nolan et al.).

Who should pay for nurses’ CPD has been disputed and discussed in the literature for some time (Ellis & Nolan, 2005; Nolan, Owens, & Nolan, 1995; Nolan et al., 2000). In recent years it has become increasingly more difficult for hospitals to provide paid time off for nurses to learn. The CNA (1998) in the policy statement, Educational Support for Competent Nursing Practice states that “[…employers of RNs have a responsibility to put mechanisms into place that foster a professional practice environment; help RNs identify their learning needs; facilitate access to educational activities; and provide support for advancing their education” (p.1)]. Although the CNA clearly outlines the responsibilities of employers related to nurses’ professional development, nurses in Canada report that they are required to subsidize and attend CPD activities on their own time (O'Brien-Pallas et al., 2005b).
Canadian nurses feel the need to fund their own CPD is attributable to the substantial increase in learning required after they enter the profession (CNAC, 2002) which is disproportionate to the funding available within hospitals to train and develop nurses. Nurse Managers in the United Kingdom (Nolan et al., 2000) support this view. Eighty percent of the managers \((n = 100)\) surveyed by Nolan recognize that there are finite organizational resources available to meet the rising learning needs of nurses. The discrepancy between learning needs and availability of financial resources is the reason often given by managers for supporting the argument that nurses partially pay for their own CPD (Nolan et al.).

Lack of funding and affordability of the CPD activity have been identified as major factors that prevent nurses from participating in CPD (Cullen, 1998; Smith, 2004). These factors have been identified as being potentially significant obstacles for junior nurses who as a group have low human capital and high learning needs, are low paid and often have significant financial constraints related to school loans or family obligations (CNAC, 2002; Smith; Cullen).

**Lack of empirical evidence related to the impact CPD on outcomes.**

The lack of funding for nurses to develop their knowledge and skills after they enter the profession is perplexing as CPD is mandated for relicensure by approximately half of the states in the United States of America (American Nurses Association [ANA], 2009) and for maintaining specialty certification in both Canada and the United States. In addition, in the United Kingdom and some Canadian provinces, nurses keep records of their participation in CPD as one method of demonstrating their competency at the time of relicensure (Witmer & Cullum, 1999).

Professional licensing bodies require nurses to participate in CPD with the assumption that it assists nurses with maintaining their professional competency. Maintenance of competency is thought to be associated with good quality and safe patient care however there is considerable controversy if participation in CPD actually maintains nurse competency and protects the public from unsafe care. Several authors have reviewed the literature in an attempt to determine the benefits of mandating CPD for relicensure (Eustace, 2001; Griscti & Jacono, 2006; Hewlett & Eichelberger, 1996; Hutton, 1986; 1987; Smith, 2004; Thurston, 1992). The authors are in agreement that an empirically established link between CPD and
patient care outcomes could not be identified and that mandating CPD for relicensure had been implemented without substantial empirical evidence to support the requirement. They called attention to multiple factors within the work environment, the individual, and the educational offering that could be responsible for changes in patient outcomes and recommend that further investigation be conducted to identify under what conditions these factors influence the knowledge and skills nurses acquire from CPD (Cervero, 1985; Eustace; Hewlett et al.; Hogston, 1995; Thurston).

The lack of evidence related to mandatory CPD’s impact on patient outcomes has contributed to the decision by the United Kingdom to not institute the requirement (Barriball, While, & Norman, 1992) and a few state licensing bodies in the United States of America to eliminate the requirement of CPD credits for relicensure (Eustace, 2001; Hewlett et al., 1996). Instead for relicensure in United Kingdom and a few provinces in Canada nurses are required to keep personal professional profiles as part of continuing competence programs. For these programs, participation in CPD is one method nurses can use to demonstrate that they have maintained their competency (CNA, 1999; Witmer et al., 1999). Investigating the relationship between CPD and patient outcomes would help determine if participation in CPD assists nurses with developing their human capital (knowledge and skills) and maintain their competency, which are believed to be necessary for the provision of high quality and safe patient care.

Although the contribution of CPD to patient care and maintenance of nurse competency remains unclear, perceived personal and organizational benefits of CPD have been investigated and are prevalent in the literature. Nurses perceive the benefits of participating in CPD as (a) increasing knowledge (Hughes, 2005; Nolan et al., 2000; Urbano, Jahns, & Urbano, 1988), (b) being professionally up to date (Hogston, 1995; Hughes; Nolan et al., 2000; Urbano et al., 1988), (c) maintaining professional competency (Hughes; Urbano et al.), (d) increasing self-confidence (Hughes; Nolan et al., 2000), (e) facilitating career development (Hughes; Urbano et al.), (f) improving practice or care (Hughes), (g) improving nurse behavior and attitudes (Hutton, 1986; Hutton, 1987), and (h) educating their colleagues (Hogston; Hughes). Sixty-eight percent of the nurses (n = 992) in a study conducted by Nolan (2000) reported that participation in CPD increases their assertiveness and self-
confidence, which enhances their contribution to clinical decision-making. However, when Smith (2004) surveyed RNs (n = 2000) related to their perception of contributors to their professional development, nurses reported that they perceive their work experience, their basic education, and mentors and preceptors as stronger contributors to their professional development than CPD. The discrepancy in these findings could indicate that nurses use more than one method to update their knowledge and skills and that the work environment is influential in the amount of professional development or growth experienced.

**Models designed to guide the evaluation of CPD initiatives.**

Although researchers have been able to determine that nurses, organizations and professional licensing bodies perceive CPD to be beneficial they have been unable to empirically demonstrate a link between CPD, and the quality of patient care and the recruitment and retention of RNs. This may be due to the lack of comprehensive and valid conceptual models that identify and delineate the relationship among variables in the work environment and their influence on knowledge and skills acquired from CPD. Identifying the characteristic variables within the work environment and their relationship to CPD is necessary in order to determine how and under what conditions CPD is associated with the quality of patient care and the recruitment and retention of RNs.

The majority of the models available to evaluate the impact of CPD have been instrumental for studying the effects of CPD activities on the learner (Abruzzese, 1996; Chater, 1975; Hawkins & Sherwood, 1999; Holzemer, 1988; Koyama, Holzemer, Kaharu, Watanbe, Yoshii & Otawa, 1996). These models focus on evaluating (a) if the learner needs were met, (b) the processes or how the educational offering was provided and learners’ satisfaction with the educational offering, and (c) the learners’ outcome subsequent to attending CPD activity, i.e. knowledge gain. The models have been helpful to educators in determining if the offering objectives were met and if the activity should be revised prior to future use; however the models fall short of determining if knowledge acquired from the learning activity are associated with the quality of patient care or the recruitment and retention of nurses. Two authors have published models designed to evaluate changes in patient outcomes. The following section reviews the models available to evaluate the effect of CPD on patient and organizational outcomes.
Models designed to evaluate CPD influence on patient and organizational outcomes.

The Roberta Straessle Abruzzese (RSA) model (Abruzzese, 1992) was developed to conceptualize the CPD evaluation process and includes evaluation levels that describe the impact of CPD on patient and nurse recruitment and retention outcomes. Although the RSA model provides good bases for evaluating the CPD offering’s direct relation to outcomes, it does not take into consideration the factors within the work environment that can potentially influence the outcomes of CPD. Therefore the RSA model does not provide an explanation as to how or why the outcomes were achieved.

The work of Donabedian, Rossi and Freeman (1993, as cited in Hawkins & Sherwood, 1999) was used to create the pyramid evaluation model (Hawkins & Sherwood). The pyramid evaluation model specifies what type of patient outcomes to be assessed, such as patient length of stay; however it does not identify the variables in the environment that can influence the achievement of patient outcomes.

Since the application of knowledge acquired from CPD could be influenced by different factors within the work environment it is understandable that researchers using these models have been unable to empirically determine if CPD improves patient care within complex hospital environments. In order to better understand the influence of the CPD on patients and organizations a different theoretical approach, which delineates the relationships among variables within the work environment, is required.

Work environment and knowledge acquired from CPD.

Specific characteristics of the work environment have been recognized as being essential for creating quality work environments for nurses. Characteristics derived from the literature on magnet hospitals such as nurse staffing and employer support for nurse CPD have been identified by nurses as influencing their ability to update their knowledge and to apply the knowledge they have acquired from CPD. Nurse staffing with a higher percentage of RNs and positive recognition through the availability of advancement opportunities and employer sponsored CPD are two characteristics that have been identified as important to creating quality work environments for nurses (Kramer & Schmalenberg, 2002; Kramer & Schmalenberg, 2004a; McClure, Poulin, Sovie & Wandelt, 1983; McClure & Hinshaw,
Work environments that maintain these characteristics have been found to benefit organizations, nurses and patients by allowing nurses to effectively use their expertise, knowledge and experience to provide high quality patient care (Upenieks, 2003a). As a result nurses in these organizations have higher job satisfaction, lower levels of burn-out, emotional strain, frustration and dissatisfaction and enhanced workplace safety (Aiken, Clarke & Sloane, 2002; Havens & Aiken, 1999; Upenieks, 2002). Organizations benefit from lower nurse turnover and vacancy rates and the retention of expert nurses (Upenieks, 2002; 2003a) as well as from lower patient mortality rates (Aiken, Havens, & Sloan, 2000; Jones-Schenk, 2001), higher patient satisfaction with their care (Jones-Schenk), and improved patient safety (Capuano, Bokovoy, Hitchings & Houser, 2005). However, an investigation of the characteristics of the work environment, nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) and their relationships to the quality of patient care and recruitment and retention of RNs within quality work environments has not been conducted.

**Nurse staffing.**

Staffing nursing units with a higher percentage of RNs is considered to be a factor that attracts and retains nurses at Magnet hospitals (Kramer et al., 2002; Kramer et al., 2004a; McClure et al., 1983; McClure & Hinshaw, 2002). Nurse staffing has also been identified as having an influence on knowledge and skills acquired from CPD and their impact on professional behavior change (Foglesong, Lambert, & Emerick, 1987). Nurses express difficulty acquiring and using knowledge from CPD if their workload is too high, if they are overworked or if staffing is insufficient (Scheller, 1993). Although nurse staffing has been investigated in terms of its impact on patient outcomes (Aiken et al., 2002; Aiken et al., 2003; Blakeman Hodge, Romano, Harvey, Samuels & Olson, 2004; McGillis Hall, Doran & Pink, 2004; Potter, Barr, McSweeney & Sledge, 2003; Sasichay-Akkadechanunt, Scalzi & Jawad, 2003) and costs (Bloom, Alexander & Nuchols, 1997; Needleman, Buerhaus & Mattke, 2002) little attention has been paid to how nurse staffing affects the use of knowledge, skills and experience of nurses (nursing human capital) and its relationship to the quality of patient care and the promotion of nurse recruitment and retention.
Employer support of nurse CPD.

Employer support for nurse CPD has been identified as another key characteristic that attracts and retains RNs who are satisfied with their jobs (Buchan, 1999). Employer support for nurse CPD includes the provision of continuing education, competency-based clinical ladders, management development programs, tuition reimbursement and scholarship programs, on-and off-site degree programs, new graduate and other types of long term internship programs (Kramer et al., 2004a) and the availability of nurse educators on the unit to provide clinical decision-making support (Upenieks, 2003a). Without evidence to explain the relationships among factors within the work environment such as nurse staffing and employer support for nurse CPD and nursing human capital (RN’s knowledge, skills and experience), it is difficult to explain how the identified factors are associated with patient and organizational outcomes. The development of a comprehensive theory will provide a greater understanding of how nurses’ work environment and their human capital (knowledge, skills and experience) are associated with outcome achievement.

In summary, the literature demonstrates the need for a clearer understanding of the relationship of the work environment, nursing human capital (nurses’ experience and knowledge and skills acquired from CPD) to the quality of patient care and nurse recruitment and retention. The lack of comprehensive theories to guide research has resulted in lack of cumulative knowledge and evidence of the impact of CPD on the quality of patient care and the recruitment and retention of nurses within acute care hospitals. The development and testing of a comprehensive theory based on intellectual capital theory will allow for the conceptualization of the hospital’s intangible asset, nursing human capital (nurses’ knowledge, skills and experience), in order to determine its contribution to organizational and nursing performance. Intellectual capital theory (Bontis, 1999; Bontis & Fitz-enz, 2002) proposes variables within the work environment that may be associated with nursing human capital (nurses’ knowledge and skills gained through CPD and experience), and subsequently nursing and organizational performance.

Problem Statement

The problem addressed in this study was the lack of a clear understanding of the relationships among factors within the work environment and their relationship to nursing human capital
(nurses’ experience, and knowledge and skills acquired from CPD) to the quality of patient care and the recruitment and retention of nurses within acute care hospitals. Although nurse participation in CPD is thought to increase nursing human capital (by developing nurses’ knowledge and skills), assist with maintaining professional competencies and protect the public from unsafe care, an empirical link between nursing human capital and the quality of patient care within acute care hospitals has not been investigated. There is also a lack of empirical evidence related to how factors within the work environment are associated with nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) and their relationships to the quality of patient care and the recruitment and retention of registered nurses. This is concerning since advances in technologies and changes in legislation require nurses to continue to develop their knowledge and skills after they enter the profession.

In addition there is an absence of valid and comprehensive theories to guide the evaluation of the influence of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) to patient and organizational outcomes. To address this gap in the literature, the theory of intellectual capital was used to derive the middle-range theory of nursing intellectual capital which conceptualizes the interrelationships among work environment, nursing human capital (registered nurses’ human capital or knowledge and skills gained through CPD, and experience), and quality of patient care and registered nurse recruitment and retention. The theory proposes direct and indirect relationships among the variables. Specifically, the theory hypothesizes that (a) the work environment (staffing, employer support for nurse continuing professional development), is directly associated with nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD), and indirectly associated with the quality of patient care (operationalized as falls, hospital-acquired infections, and medication errors), and nurse retention (turnover, vacancy rates) and orientation hours; (b) nursing human capital or registered nurses’ knowledge and skills (academic preparation, CPD, specialty certification) and experience (years in nursing, specialty, unit tenure) have direct relationships to the quality of patient care, retention, and costs of orientation. The theory also proposes that nursing structural capital (nursing knowledge contained within care maps, practice guidelines, and protocols) has a direct relationship to the quality of patient care.
Purpose of the Study
The purpose of this study was to test selected propositions of the middle-range theory of nursing intellectual capital. The theory delineates relationships among factors within the work environment (employer support for nurse CPD and nurse staffing), nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD), and the quality of patient care and recruitment and retention of nurses.

Significance of the Study
A valid and comprehensive theory provides guidance for the evaluation of the contribution of nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) to outcomes for patients and the organizations in which they work. Decision-makers, regulatory bodies, professional associations, employers and governments will be able to use findings from this study for informed decision-making related to hospital funding, staffing and budgeting, professional licensure, nurse CPD, and the recruitment and retention of RNs. Findings from the study could also be used to guide policy development regarding registered nurse preparation and participation in CPD.

Summary
In summary, although there is extensive use of CPD within the profession and reports that it positively affects nursing practice, it remains controversial if nurse participation in CPD actually increases nursing human capital and improves patient or organizational outcomes. The associations of factors within the work environment to nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) have not been clearly delineated nor have the underlying mechanisms been explained. Studying the multiple factors that are associated with nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD), and their relationship to the quality of patient care and nurse recruitment and retention provides a better understanding of the contribution of nurses to patient and organizational outcomes. A comprehensive and valid theory provides clear conceptualization to guide research and aid administrative decision-making and policy development related to the ongoing education of RNs.
Chapter 2  
Nursing Intellectual Capital Theory

This chapter presents the middle-range nursing intellectual capital theory that guided the research project. It is divided into three main sections: a review of intellectual capital theory from which the middle-range nursing intellectual capital theory was derived, the middle-range nursing intellectual capital theory, and the empirical support for the middle-range nursing intellectual capital theory propositions, which this study tested.

The theoretical and empirical support provided below was obtained from a critical review of the intellectual capital and nursing literature by using the search terms: intellectual capital, human capital, structural capital, customer capital, relational capital and social capital. Review of the indices and abstract databases included: Psych Info, Cumulative Index to Nursing and Allied Health Literature, Dissertation Abstracts International, and Index Medicus. Peer-reviewed English language books and periodicals and trade books that had the search terms in their title were included. Individual journals were hand searched. Forty-seven citations were retained and their content integrated into a coherent presentation of the middle-range theory, as reflected in the following three sections.

Intellectual Capital Theory

Intellectual capital (IC) and its related concepts have been the topic of several commercial and trade books (Cohen & Prusak, 2001; Edvinsson & Sullivan, 1996; Stewart, 1997; Sullivan, 1998; Stewart, 2001); however intellectual capital theory has been primarily explored and extended by Dr. Nick Bontis of DeGroote Business School at McMaster University in Hamilton, Ontario, Canada. Intellectual capital (IC) theory originates from the disciplines of economics (Machlup, 1982) and accounting (Dzinkowski, 2000) and is grounded in organizational learning concepts (Crossan, Lane, & White, 1999). IC theory delineates the stocks and flow of knowledge within organizations (Bontis, 1999). It is composed of knowledge stocks that reside within employees as well as those incorporated in the organization’s products, systems and structures (Bontis). IC theory proposes a relationship between knowledge stocks at all levels of the organization. As an increase in individual, group and organizational knowledge stocks occurs, business performance also improves (Bontis). An increase in knowledge stocks can occur through organizational
investment in learning and hiring or retaining employees. Human capital is the individual knowledge stocks or the knowledge, skills, and experience within an individual (Bontis, 1998; 1999). Structural capital includes group-level knowledge stocks which are embedded in organizational systems and structures (Bontis, 1998).

“The alignment of knowledge stocks and flow occurs when the knowledge flow is sufficient in relation to levels of knowledge stocks” (Bontis, 1998, pg. 51). Alignment of knowledge stocks allows for the flow of knowledge acquired from experience, such as learning from others, to be used to create concrete knowledge such as written information (Bontis, 1999). “This continuous and dynamic interaction between knowledge within the organization results in greater organizational performance” (Bontis, 1999, p.25).

“Misalignment [of knowledge stocks and flows] is defined as the difference between levels of knowledge stocks and flows” (Bontis, 1999, p. 47). If a misalignment between the amount of knowledge stocks and flows exists, or if the knowledge does not flow within the organization, business performance can be negatively affected (Bontis). The misalignment of stocks and flow of knowledge occurs when the organization (a) restricts communication between employees or within the organization, (b) has a poor information system, or (c) has poor leadership (Bontis). When individual stocks of knowledge are not shared the organization cannot benefit from the knowledge acquired by different individuals and groups. Without knowledge sharing between employees, new knowledge or ideas cannot be created. The alignment of knowledge stocks and flows allows the organization to achieve greater efficiency in its organizational learning system and thus greater relative business performance (Bontis).

The stocks of knowledge held within the individual (human capital) and stored within the organization (structural capital) are diffused through the use of the organization’s network relationships (Bontis, 1999). It has been suggested that social networks assist organizations with learning and innovation by increasing the efficiency of information diffusion, encouraging cooperative behavior, and reducing the costs of transactions (Youndt, Subramanian & Snell, 2004). Social networks may facilitate the development of intellectual capital by creating the conditions necessary for knowledge exchange.
Theoretical discussions related to the concepts of intellectual capital and their proposed relationship to business performance are prevalent in the literature (Brass, Galaskiewicz, Greve & Tsai, 2004; Edvinsson & Malone, 1997; Edvinsson & Sullivan, 1996; Inkpen & Tsang, 2005; Kessels & Poell, 2004; Leana, 1999; Lepak & Snell, 1999; Machlup, 1982; Nahapiet & Ghoshal, 1998; Nerdrum & Erikson, 2001; Seibert, Kraimer, & Linden, 2001; Stohle & Stohle, 2003). The work of these theorists have been instrumental in advancing the conceptualization of the intellectual capital theory whereas researchers have been successful in providing empirical support of the association among the theory’s concepts and organizational performance (Bontis, 1999; Bontis & Fitz-enz, 2002; Youndt et al., 2004).

Publications presenting findings from empirically testing the theory of intellectual capital are few in number but consistent in their findings (Bart, 2001; Bontis, 1998; 1999; Bontis & Fitz-enz, 2002; Youndt et al., 2004). All five studies found a positive association among the IC concepts and the development of IC and business performance. Studies exploring the related concepts of IC, human capital, structural capital, social capital, and relational capital and their relationships to (a) each other (Bontis, 1998; 1999; Bontis & Fitz-enz, 2002; Youndt et al., 2004), (b) organizational traits (Kale, Singh & Perlmutter, 2000; Leana, 1999; Pearce & Randel, 2004; Seibert et al., 2001), (c) employee characteristics (Lin & Huang, 2005; Pearce & Randel; Watson & Papamarcos, 2002; Wayne, Linden, Kraimer & Graf, 1999), and (d) business performance (Tsai & Ghoshal, 1998) have also contributed to an increased understanding of the contribution of IC to business organizations. However, the findings from these studies have limited generalizability outside of the field of business due to the specificity of the studies’ samples.

**Definition of the Intellectual Capital Concepts**

Intellectual capital (IC) is knowledge that can be translated into organizational profits and/or business performance (Sullivan, 1998). IC management is the process of effectively using knowledge in order to gain a competitive advantage for an organization (Edvinsson & Malone, 1996; Stewart, 1997; Youndt et al., 2004). IC is composed of three domains: human capital, structural capital and relational capital (Stewart, 1997). Organizations with high IC have been found to outperform organizations with less IC as measured by stronger financial returns ($F = 3.13, p < 0.01$) and financial performance ($F = 3.04, p < 0.01$; Youndt et al).
**Human capital.**

Human capital is the primary component of intellectual capital and is defined as the knowledge, talent and experience of employees (Bontis & Fitz-enz, 2002; Edvinsson & Malone, 1996; Stewart, 1997; Sullivan, 1998). Human capital resides within the employee and is not owned by the organization but rather loaned to the organization by the employee (Sullivan) and leaves with the employee when s/he separates from the organization (Stewart, 1997; Sullivan). Human capital constitutes the intangible assets of organizations (Stewart, 2001). Investing in employees’ knowledge and skill development, through formal education, informal learning opportunities and providing information increases the stocks of knowledge within the person (Stewart, 2001). This increase in human capital improves the individual’s productivity and marketability (Nerdrum & Erikson, 2001). The development of human capital has been found to be related to the education level of the organization’s employees ($r = 0.691$, $p < .01$: Bontis & Fitz-enz). Replacing the human capital of employees that leave the organization is difficult and expensive.

Human capital grows when organizations use the knowledge that their employees have and when the employees have knowledge that the organization can use. Viewing human capital as an organizational construct allows organizations to determine how much and where human capital should be acquired or developed (Stewart, 1997). Allowing employees to work together provides an opportunity for employees to benefit from their colleagues’ knowledge, skills and experience thus increasing their human capital (Cohen & Prusak, 2001). These activities provide opportunities for knowledge generation, integration and sharing which produce strong performing organizations (Stewart, 2001). Business performance has been found to be negatively associated with human capital depletion ($\beta = -0.372$, $p < 0.05$: Bontis & Fitz-enz, 2002).

**Structural capital.**

Structural capital influences business performance by providing access to information or knowledge that is incorporated within the organization’s structures and routines (Stewart, 1997). Structural capital is the support structure for human capital and it belongs to the organization as a whole (Bontis, 2002; Stewart). Examples of organizational structural capital are inventions, technologies, data, publications and processes that can be sold,
reproduced, patented, or copyrighted (Stewart). Structural capital has been found to be directly and positively associated with business performance ($\beta = 0.373, p < 0.001$; Bontis, 1998; $\beta = 0.455, p < 0.001$; Bontis, 1999).

**Relational capital.**
Relational capital represents the knowledge embedded in the organization’s relationship with internal and external stakeholders. Relational capital is thought to be important for increasing an organization’s knowledge as it creates social networks that permit the sharing of information or knowledge between the organization and external stakeholders (Liu, Ghauri, & Sinkovics, 2010). Yet, it can be difficult to develop and retain because it involves stakeholders that are external to the organization (Bontis & Fitz-enz, 2002; Ordonez de Pablos, 2002). Relational capital has been found to be positively associated with effective use of human capital ($\beta = 0.360, p < 0.05$; Bontis & Fitz-enz, 2002).

**Antecedents to human capital.**
An antecedent variable is a variable that precedes and influences other variables. Human capital depletion and human capital investment are two variables found to be associated with human capital development.

**Human capital depletion.**
Bontis and Fitz-enz (2002) identified an association between a stable organizational membership and human capital development. Turnover of the organization’s employees depletes the organization of human capital. Turnover also makes the development of organizational human capital very difficult because it creates an unstable employee base. Reduction of turnover and the retention of key people are instrumental for the retention of organizational human capital. Human capital depletion has been found to be negatively associated with effective use of human capital ($\beta = -0.337, p < 0.05, R^2 = 28.5\%$; Bontis & Fitz-enz) and negatively associated with organizational performance ($\beta = -0.372, p < 0.05$; Bontis & Fitz-enz).
**Human capital investment.**

The organizations’ investment in their employees’ knowledge is an important contributor to the development of organizational human capital and innovation. Organizations invest in their human capital through training and development initiatives. Organizational investment in training and development measured as the average dollar amount spent on training for each employee has been found to be positively associated with the development of human capital ($\beta = 0.530$, $p < .05$) and indirectly related to effective use of human capital (Bontis & Fitz-enz, 2002).

**Performance outcomes.**

Performance Outcomes are achieved by investing in human capital resources which will produce future returns for the organization by creating intellectual assets or improving performance (Sullivan, 1998). Intellectual assets including organizational systems, structures and routines that are developed from the organization’s human capital have been found to be positively associated with business performance (Bontis, 1998; 1999). Business performance has been measured as (a) perceived current performance (Bontis & Fitz-enz, 2002), (b) perceived future outlook for the business (Bontis, 1998), and (c) financial performance (Bontis, 1998; 1999; Youndt et al., 2004).

**Intellectual Capital and Health Care**

The application of intellectual capital theory to health care has recently been explored by a number of authors (Collins & Collins, 2006; Davidson, 2007; Ehrat, 2001; Faulk, 2007; Gopee, 2002; Grantham, Nichols & Schonberger, 1997; Habersam & Piber, 2003; Hart, 2006; Hudspeth, 2006; Kocakülâh & Harris, 2002; McGillis Hall, 2003; Shirey, 2006; Simpson, 2007; Thomka, 2007; Weston, Estrada & Carrington, 2006). Intellectual capital or its related concepts, human capital, structural capital, relational capital and social capital have been used to frame discussions in the health care and nursing literature related to the (a) recruitment and retention of employees (Kocakülâh & Harris, 2002), (b) retention of the aging nursing workforce (Collins et al., Faulk), (c) marketability of nurses’ knowledge and skills (Hudspeth, Shirey), (d) leadership and mentorship of nurses (Davidson; Ehrat; Thomka), (e) use of information technology for the promotion of evidenced-based practice (Simpson), (f) creation of quality work environments for nurses (Weston et al.), and
conceptualization of nursing knowledge as “a corporate asset and vital strategic resource” (Donaldson, 1998, p. 1). Although many of the articles are not theoretical or empirical in nature they do provide support for the relevance of applying intellectual capital theory to nursing.

Grantham et al. (1997), Gopee (2002) and McGillis Hall (2003) developed and published intellectual capital conceptual frameworks for nursing or health care organizations. Grantham et al. (1997) generated a framework for the management and measurement of intellectual capital within the health care industry. The authors’ cone and cylinder model provides a “hierarchical dimension to intellectual capital and a method of scientific visualization of [its] measurement” (Grantham et al., p.1). Grantham et al. propose that the amount of intellectual capital differs according to the level of responsibility within the organization. By using the cone and cylinder model the authors believe it is possible to measure intellectual capital at different levels of responsibility throughout the organization. The model provides a unique method for categorizing intellectual capital which is different from the traditional categories of human, structural and relational capital. The authors clearly state that they do not propose that there is a relationship between the six dimensions of communication categories used to reflect intellectual capital within their model and the traditional categories of intellectual capital. However, the model proposed by Grantham et al. offers the conceptualization and measurement of intellectual capital at various levels within the organization and identifies the area of the hospital where employees are involved in the “day-to day operations” to be where the greatest numbers of employees are using intellectual capital to perform their jobs. This observation provides theoretical evidence for conceptualizing intellectual capital within acute care hospitals at the group or nursing unit-level.

Gopee (2002) presents a conceptual model of human and social capital factors that influence life-long learning which he proposes leads to the enhancement of patient care. Using data from 27 semi-structured individual interviews and two focus groups with RNs, the author identified three factors of human and social capital (social investment, employer investment and self investment), which nurses believe promote life-long learning and in turn the quality of patient care. The human and social capital factors which can negatively influence RN’s life-long learning include the clinical setting, academia, management, self investment, lack of
support from parents, family and friends, social attitudes, and government. The author concludes that by facilitating the development of social and human capital nurses will continue to learn and patient care will be of high quality. Gopee’s contribution to the intellectual capital literature is the identification and conceptualization of the factors that influence the development of nurses’ human and social capital. His work provides theoretical support for the inclusion of employer investment as a facilitator of nursing human capital in the middle-range nursing intellectual capital theory.

McGillis Hall (2003) published a nursing intellectual capital conceptual model designed to analyze nursing productivity within health care organizations. Based on systems theory the model contains nursing knowledge development variables at the level of the nurse (education, experience, career planning and development, autonomy, organizational trust, organizational commitment, and job satisfaction) and the organization (organizational support for knowledge development); and nursing productivity variables at the level of the system (nursing costs, nursing turnover, nursing absenteeism, nursing replacement costs, nursing orientation costs, nursing education costs) and the patient (nursing errors related to patient safety and patient satisfaction with nursing care). The author provides definitional statements and indicators to measure each variable within health care organizations. Her work on variable identification, definitional statements and indicator development are instrumental steps towards defining and measuring intellectual capital within health care organizations.

Empirical findings investigating intellectual capital within the health care industry are limited to the work of Habersham and Pier who conducted a qualitative study to explore the applicability of IC concepts in two European hospitals. Exploring the perceptions of managers, Habersham and Pier found that managers believed IC theory to be highly relevant for their organizations. However, the applicability of IC theory to hospitals has not been tested empirically; therefore it remains unclear if the theory can be successfully applied to hospitals. Since hospitals rely heavily on the knowledge, skills and experience of their employees for provision of high quality patient care the application of IC theory to nursing could provide a better understanding of how the knowledge, skills and experience of nurses affect the quality of patient care and the recruitment and retention of nurses.
In order to redefine the theory of intellectual capital for nursing, it was necessary to critically review the nursing literature for concepts related to knowledge and experience that are consistent with those advanced by the theory (Walker & Avant, 2005). Guidelines by Cooper (1998) were used to search and review the literature. Key words were selected based on the elements of the human capital of knowledge, skills, and experience. The search terms used for knowledge and skills included: continuing education, continuing professional development, continuing professional education, professional development, in-service education, academic education, and specialty certification. For experience, the search terms included: experience in nursing, professional experience in nursing, and organizational tenure in nursing. The review encompassed the period of 1975 to 2007 and included the following indices and abstract databases: Cumulative Index to Nursing and Allied Health Literature, Dissertation Abstracts International, Index Medicus, and Psych Info. Peer-reviewed English language books and periodicals, which had the search terms in their title or summary, were included in the review. Searches were conducted of individual journals by hand. The World Wide Web was used to review the grey literature including reports from national, provincial, state regulatory and professional bodies. The search produced 132 papers and was then limited to papers examining the relationships between indicators of human and structural capital and patient and organizational outcomes, as proposed in the theory. A total of 61 papers were retained. Their content was integrated to derive the middle-range theory of nursing intellectual capital.

The process of theory development and derivation as outlined by Walker and Avant (2005) was used to generate the middle-range nursing intellectual capital theory. The concepts of intellectual capital as presented in the business literature were used as blue prints. After critically reviewing the IC and nursing literature, the strategies of concept analysis, concept synthesis and concept derivation were used to develop the parallel concepts in nursing. Critical analysis of the literature was conducted to determine the concepts of nursing intellectual capital, the influencing factors and outcomes, as well as the interrelationships among the three categories of concepts. This process allowed for previously unrelated information to be connected while each concept and its related statements were clarified (Walker & Avant). The following section presents the middle-range nursing intellectual capital theory that this study tested.
Nursing Intellectual Capital Theory
The middle-range theory of nursing intellectual capital proposes that nursing human capital and nursing structural capital are related to nursing and organizational performance. Nursing human capital is defined as the stocks of knowledge within registered nurses, and nursing structural capital as stocks of nursing knowledge within the organization. An increase in nursing knowledge stocks can occur by investing in the CPD of RNs, and hiring and retaining competent nurses. Stocks of knowledge within nursing are diffused throughout the nursing unit via the unit’s social network. Social networks in nursing are formed through interpersonal contacts and relationships (Bauer, 1991). Social networks in nursing have been identified as essential for the development of new knowledge, innovation or creating professional behavior change within the organization (Thomson, Estabrooks & Degner, 2006).

There is evidence that nurses use social networks to learn (Bauer, 1991; Kramer & Schmalenberg, 2004a; Hogston, 1995; Hughes, 2005; Smith, 2004) and increase their knowledge; which could lead to improvements in patient care. Several of the studies that report improvements in patient outcomes as the result of nurse participation in CPD include the implementation of modalities that involve the interaction among nursing staff (Dufault & Sullivan, 2000; Salahuddin et al., 2004). Reported modalities include the (a) implementation of practice guidelines, (b) rounds, (c) meetings, and (d) total quality management programs. Therefore for these studies it becomes difficult to discern which modality or combination of modalities was directly responsible for improving the quality of patient care. It can however be surmised that nurses’ interactive participation in the assessment, planning, learning and evaluation incorporated in these projects facilitated the use of the units’ learning networks to share the knowledge, skills and experience acquired by the staff and was instrumental for the achievement of the reported improvements in patient care.

The assumption that nurses’ interactive participation in CPD leads to their sharing of the newly acquired information is supported by the work of Waddell (1992). She determined through a meta-analysis of 34 studies that greater professional behavior changes occur when participants were from the same work setting rather than when they were from multiple settings. O’Brien, Freemantle, Oxman, Wolf, Davis, and Herrin (2001) also found through a
systematic review of 32 studies with a total of 36 comparisons that CPD which employed interactive workshops, meeting or courses were more likely to lead to improvements in professional practice than educational offerings that were solely didactic in design. Therefore, social networks within nursing units may facilitate the development of nursing intellectual capital by creating the conditions necessary for knowledge exchange to occur.

For this study the investigation was limited to the IC constructs of nursing human capital and nursing structural capital and related antecedents, and their relationship to patient and organizational outcomes. Relational capital was not included in the investigation as the concept was not well developed within the business literature and its application to nursing knowledge (human and structural capital) at the unit-level was not theoretically meaningful. Theoretical (Grantham et al., 1997) and empirical (Bontis, 1998) evidence led to the constructs for study to be successfully derived at the level of the nursing unit. The following section presents the (a) derivation of IC concepts to nursing, (b) definitions of the concepts and antecedents, and (c) their relationships with quality of patient care and nurse recruitment and retention outcomes. Figure 1 presents the middle-range nursing intellectual capital theory as derived from the literature.

**Nursing intellectual capital.**

Nursing intellectual capital refers to the knowledge, skills and information that reside within the organization. It is composed of two interdependent concepts (a) nursing human capital, and (b) nursing structural capital. The theory proposes two factors that are associated with the two components of intellectual capital. The factors are characteristics of the work environment and include nurse staffing and employer support for nurse CPD. Nursing intellectual capital is related to nurses’ performance, manifested by quality of patient care and the organization’s performance such as the recruitment and retention of RNs. The intellectual capital concepts and their corollary in nursing are presented in Table 1.

**Antecedents of nursing human capital: work environment.**

Factors within the work environment that have been identified as potentially associated with the acquisition and application of nurses’ knowledge and skills acquired from CPD include nurse staffing and employer support for nurse CPD. These antecedents may be associated
with the unit’s human capital development, and in turn, the quality of patient care and nurse recruitment and retention.

**Nurse staffing.**

Human capital depletion is reflected in nurse staffing levels. The nursing shortage has resulted in the inability of some organizations to retain or recruit experienced RNs. The retention of RNs with knowledge, skills and experience preserves the unit’s nursing human capital. This leads to the availability of knowledgeable, skilled and experienced nurses to competently care for patients. In addition, units that retain their nurses will have lower nurse turnover and less unfilled positions which create a stable nurse staffing base. Low turnover and vacancy rates have been found to be associated with higher staff expertise (Capuano et al., 2005). Nurse staffing is defined as the supply of RNs and mix of nurses who possess the knowledge and skills to competently meet the care needs of patients on the unit (ANA, 1999).
Figure 1. Middle-Range Nursing Intellectual Capital Theory

- Nurse Staffing
- Employer Support for Nurse CPD
- Nursing Human Capital
- Nursing Structural Capital
- Quality of Patient Care Outcomes
- Recruitment and Retention Outcomes

Key concepts:
- Nurse Staffing
- Employer Support for Nurse CPD
- Nursing Human Capital
- Nursing Structural Capital
- Quality of Patient Care Outcomes
- Recruitment and Retention Outcomes
Table 1. *Intellectual Capital Concepts and their Corollary in Nursing*

<table>
<thead>
<tr>
<th>Intellectual Capital Theory</th>
<th>Nursing Intellectual Capital Theory</th>
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<tr>
<td>Intellectual Capital is knowledge that is translated into business performance (Bontis, 1999).</td>
<td>Nursing Intellectual Capital is knowledge that is translated into nursing and organizational performance.</td>
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<tr>
<td>Business Performance leads to organizational profits and the retention of key people (Bontis &amp; Fitz-enz, 2002).</td>
<td>Nursing Performance leads to improvements in the quality of patient care (McGillis Hall, 2003). Organizational performance leads to the retention of knowledgeable and experienced registered nurses.</td>
</tr>
<tr>
<td>Human Capital is the knowledge, talent and experience of employees (Edvinsson &amp; Malone, 1997).</td>
<td>Nursing Human Capital is the knowledge, skills and experience of nurses (McGillis Hall, 2003).</td>
</tr>
<tr>
<td>Structural Capital is organizational knowledge that exists within the organization’s filing cabinets, databases and organizational routines (Edvinsson &amp; Malone, 1997) and supports the use of human capital within the organization (Bontis, 2002).</td>
<td>Nursing Structural Capital is nursing knowledge converted into information that exists within practice guidelines (Stewart, 1997), care maps and protocols, which supports the use of nursing human capital (McGillis Hall, 2003).</td>
</tr>
<tr>
<td>Human Capital Depletion is the loss of employees with knowledge and skills that are of value to the organization (Bontis &amp; Fitz-enz, 2002).</td>
<td>Nurse Staffing is the available supply of nurses who possess the knowledge, skills and experience to competently care for patients on the unit (ANA, 1999).</td>
</tr>
<tr>
<td>Human Capital Investment is the investment by organizations in the development of employees’ knowledge and skills through training and development (Bontis &amp; Fitz-enz, 2002).</td>
<td>Employer Support of Nurse CPD is the investment by the organization in the knowledge and skill development of nurses through continuing professional development activities.</td>
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Employer support for nurse CPD.
Employer support for nurse CPD is a set of behaviors and beliefs demonstrated by the organization that promote and value the education of nurses after they enter the profession (Kramer & Schmalenberg, 2004a). Employer support for nurse CPD is the investment of the organization in the knowledge and skill development of nurses through CPD activities.

Nursing human capital.
Nursing human capital is defined as the knowledge, skills and experience of nurses. Nursing human capital includes the attributes of knowledge, skills and experience nurses acquire after they enter the profession.

Nursing structural capital.
Nursing structural capital is nursing knowledge converted into information that exists within material resources, such as practice guidelines. Nursing structural capital is used to support work of nurses by facilitating the application of their knowledge, skills and experience to the delivery of quality patient care (McGillis Hall, 2003; Miller & Kearney, 2004).

Nursing intellectual capital outcomes.
Two categories of performance outcomes were identified as possibly being associated with nursing intellectual capital. They include outcomes related to quality of patient care and the recruitment and retention of nurses.

Quality of patient care.
Nursing performance leads to quality patient care and may be affected by nursing knowledge (McGillis Hall, 2003). Quality of patient care is often defined as the provision of safe patient care or care that does not harm or injure patients. An incident that causes harm to patients is referred to as an adverse event; it is defined as a medical condition that develops after admission and has an impact on the patient’s treatment or outcomes (CIHI, 2007). An adverse event can cause injury to a patient, which can result in either a prolonged hospitalization or disability at discharge (Thomas, Studdert & Brennan, 2000). Nursing human capital, registered nurses’ experience and knowledge and skills acquired from CPD have been found to contribute to improvements in patient care (Blegen et al, 2001; Bulla, 2003; Salahuddin et al., 2004). Nursing structural capital, that is nursing knowledge
embedded in care maps, practice guidelines and protocols, has also been found to influence the quality of patient care (Gill & Ursic, 1994; Hansell & Heinemann, 1996; Lord, Tiedemann, Chapman, Munro, Murray & Sherrington, 2005; Salahuddin et al.). Nursing human capital, registered nurses’ experience, and knowledge and skills acquired from CPD have been found to contribute to improvements in patient care (Blegen et al., Bulla; Salahuddin et al.). Therefore, it is proposed that the provision of quality or safe patient care may occur as a result of nursing knowledge (human and structural capital) and is demonstrated in low rates of adverse events (patient falls, medication errors, hospital-acquired infections).

**RN recruitment and retention outcomes.**

CPD activities in the form of employer sponsored workshops, short programs and specialty certification have been used as recruitment strategies by many organizations (Kramer et al., 2004a; Miller & Kearney, 2004; O'Brien-Pallas et al., 2004; O'Brien-Pallas, Meyer & Thomson, 2005a; O'Brien-Pallas et al., 2005c; Sechrist et al., 2004; Upenieks, 2002). Organizations that provide opportunities for nurses to develop knowledge and skills are more likely to retain a competent and skillful nursing workforce (Fletcher, Guzley, Barnhill, & Philhour, 2004; Upenieks, 2002). Nurse recruitment and retention outcomes include the RN hours used for orientation, and nurse recruitment, turnover and vacancy statistics.

**RN orientation hours.**

One type of hospital performance measured by governments is financial performance. A more highly experienced, skillful and knowledgeable workforce should be more productive and thus decrease costs for organizations. Nursing tenure of 5 years or greater has been found to be significantly related to lower operating costs (Bloom et al., 1997). However, it has not be empirically determined if nurse participation in CPD directly affects nursing orientation costs within acute care hospitals. Orientation costs include the salaries required for the introduction of new employees to the organization, work environment and job requirements (McGillis Hall, 2003). Since costs can vary across units and sites due to differences in salaries, the proportion of RN orientation hours can be used as a measure of orientation costs.
RN recruitment and retention statistics.

Turnover can result in the loss of competent and skillful nurses. An organization that supports the CPD of nurses retains RNs, thus reduces turnover and the depletion of nursing human capital. Participation in CPD has been found to increase nurse self-confidence and job satisfaction (Hughes, 2005; Nolan et al., 2000), which could contribute to a low nurse turnover and vacancy rate, and a high nurse retention (Upenieks, 2002; 2003a; 2003b). Retention rates are reflected in RN recruitment, turnover and vacancy rates.

Proposed Relationships of the Middle-Range Theory

Explaining the direct relationship of RNs’ experience and knowledge and skills acquired from CPD with the quality of patient care within acute care hospitals was the primary purpose for developing the theory of nursing intellectual capital. However, a comprehensive evaluation of these relationships requires consideration of factors within the work environment and their potential relationship to the knowledge, skills and experiences of RNs and on quality of patient care and RN recruitment and retention. The subsequent section presents the proposed relationships among the theory’s concepts and the propositions tested in this study. The empirical evidence supporting the proposed relationships, the operational and empirical definitions of the concepts and the study hypotheses are presented next.

Propositions of the middle-range nursing intellectual capital theory include:

1. Nurse staffing is associated with nursing human capital.
2. Employer support for nurse CPD is related to nursing human capital.
3. The nursing human capital is directly associated with quality of patient care and recruitment and retention outcomes.
4. The nursing structural capital is directly associated with quality of patient care.
**Study propositions.**

The propositions (P) of the middle-range theory of nursing intellectual capital that were tested in this study are illustrated in Figure 2.

P1. Nurse staffing is directly and positively associated with nursing human capital.

P2. Employer support for nurse CPD is directly and positively associated with the nursing human capital.

P3. The relationship between nurse staffing and the quality of patient care is mediated by nursing human capital.

P4. The relationship between nurse staffing and RN recruitment and retention is mediated by nursing human capital.

P5. The relationship between employer support for nurse CPD and the quality of patient care is mediated by nursing human capital.

P6. The relationship between employer support for nurse CPD and the RN recruitment and retention is mediated by nursing human capital.

P7. Nursing human capital is directly associated with the quality of patient care, that is the unit’s rates of patient falls, hospital-acquired infections and medication errors.

P8. Nursing human capital is directly associated with RN recruitment and retention that is the proportion of earned hours allocated for the orientation of newly hired RNs and the unit’s rates of RN turnover, recruitment and vacancy.

P9. Nursing structural capital is directly associated with the quality of patient care, that is the unit’s rates of medication errors, hospital-acquired infections and patient falls.
Figure 2. The Conceptual-Theoretical-Empirical Structure for the Middle-Range Nursing Intellectual Capital Theory

- Skill-Mix
- RN-Patient Ratio
- Hours per Patient per Day (HPPD)

Nurse Staffing

- Clinical Educators
- Financial Assistance
- Replacement Staff
- Time Off to Learn

Employer Support for Nurse CPD

- Practice Guidelines
- Care Maps
-Protocols

Nursing Human Capital

- Academic Preparation
- Specialty Certification
- Continuing Education (CE)
- Experience
- Tenure

Nursing Structural Capital

- Quality of Patient Care Outcomes
  - Rates of Adverse Events
    - Medication Errors
    - Patient Falls
    - Hospital-acquired Infections

- Cost-Related Organizational Outcomes Associated with the Recruitment and Retention of RNs
  - RN Orientation Hours
  - RN Turnover Rate
  - RN Vacancy Rate
  - RN Recruitment Rate
Empirical Literature Related to the Middle-Range Theory Propositions

The following section presents the empirical evidence supporting the middle-range theory propositions. The empirical evidence is presented first for the theory’s main concepts (nursing human capital) and related outcomes and antecedents followed by nursing structural capital.

**Nursing human capital and quality of patient care.**

Quality of patient care or the rate of adverse events that have been found to be related to nursing human capital include (a) medication errors (Blegen et al., 2001; Bulla, 2003), (b) hospital-acquired infections (Salahuddin et al., 2004), and (c) patient falls.

**Nursing human capital and medication errors.**

Bulla (2003) studying the effect of specialty certification on medication errors reported nonsignificant differences in the number, type and severity of errors committed by certified and non-certified RNs. After reviewing the incident report data to identify errors reported as being committed by nurses and verifying the errors with pharmacy records and human resource records, Bulla found that certified RNs made fewer medication errors \( n = 9, \ 15.5\% \) than non-certified RNs \( n = 49, \ 84.5\% \) and did not commit errors of wrong patient, wrong time or wrong technique. The most common error made by both groups was administering the wrong dose of medications \( n = 17, \ 29.3\% \). No differences between certified and non-certified RNs were also noted for the severity of errors committed \( t = .579, \ p = .565 \); the errors committed by both groups caused no harm to the patients and were insignificant. Bulla surmised the group differences in the type of errors reported could be the result of certified RNs (a) being able to catch errors before they occurred while non-certified RNs could not, and (b) not reporting errors that were not likely to cause harm, (e.g. wrong time). However, the author did not control for experience and academic preparation or examine factors within the work environment that could have affected the rate of medication errors committed by both groups. Since the sample consisted of RNs employed in a military hospital where a majority of the nurses were academically prepared at the bachelor’s level and certified RNs often have greater experience than the non-certified RNs it remains unclear how these factors could have affected the nurses’ ability to use the knowledge they had acquired from specialty
certification while administering medications. Conducting the analysis at the nurse level also limited the researchers’ ability to determine if factors within the work environment could have been instrumental in reducing the difference in the outcomes between the two groups. Findings from this study indicate that the effect of nurse specialty certification on safe medication administration has not been established and further investigation is required.

Blegen et al. (2001) studied the effects of academic education and experience within a large tertiary-care hospital on the quality of patient care as measured by the number of medication errors and patient falls. Performing secondary analysis of data collected from patient care units, they found a lower number of medication errors \((n = 107, \beta = -0.34, p < .05)\) and patient falls \((n = 149, \beta = -0.37, p < .05)\) on units that employed a greater number of RNs with 5 years experience or more. The same association was not found between the nurse academic preparation and number of falls or medication errors. This study did not consider factors within the work environment that could be associated with the use of nurses’ knowledge acquired from academic education or experience on the number of medication errors and patient falls which could have accounted for the discrepancies in the findings. Additional research is required to determine if factors within the work environment such as nurse staffing or employer support for CPD affect the relationship between knowledge and skills acquired from academic preparation and experience and quality of patient care as measured by the unit rate of medication errors and patient falls.

**Nursing human capital and hospital-acquired infections.**

Salahuddin et al. (2004) evaluated a multifaceted workplace learning program, which resulted in significant quality of care outcomes related to hospital acquired pneumonia. Using a pre-test, post-test design the researchers evaluated the effects of an intervention which included weekly lectures, departmental presentations, reinforcement at the bedside and visual reminders, used to implement practice guidelines for the prevention of ventilator-associated pneumonia (VAP). The results showed a significant reduction (51%) in the VAP infection rate within the critical care unit of an acute care hospital \((\text{MD} = 6.7, 95\% \text{ CI}, p = .02)\), one year following the educational program and guideline implementation. Because this study used different modalities to reduce the rate of VAP, it is difficult to discern what
effect the development of nurses’ knowledge and skills alone had on the reduction of VAP within the unit. In addition, the researchers did not take into consideration the work environment and its possible impact upon the elements of the intervention and the reduction in the VAP rate. It therefore is unclear if the knowledge acquired from nurses participating in the educational workshop had a direct effect on improving the care of ventilator dependent patients leading to the reduction in the rate of VAP. Furthermore the modalities were provided to the unit’s multidisciplinary team of health care professionals thus possibly increasing the multidisciplinary team members’ knowledge and skills; the team members’ increased knowledge and skills also could have led to a reduction in the unit VAP rate. Additional research is necessary to determine the relationship of nursing human capital to the incidence of hospital-acquired infections.

**Nursing human capital and patient falls.**

The literature review conducted for this study revealed a scarce amount of empirical investigation of the direct relationship of nursing human capital to patient falls. Education in the form of CPD is often used as a component of falls prevention programs which have been found to be effective in (a) increasing staff awareness of high risk patients and effective prevention strategies (Browne & Covington, 2004; The Joanna Briggs Institute, 2004), (b) improving patient and family education (The Joanna Briggs Institute, 2004; Vassallo et al., 2004), and (c) reducing the severity of the injury resulting from a fall (McCarter-Bayer & Hall, 2005; The Joanna Briggs Institute, 2004). Only one study could be located that investigated the impact of RNs’ knowledge, skills and experience on the rate of patient falls. Blegen et al. (2001) studying the effects of the experience of nurses on medical-surgical units and the number of patient falls found a statistically significant negative association between the number of patient falls and registered nurse experience of 5 years or greater (n = 149, \( \beta = -0.37, p < .05 \)). This finding implies that units with a greater number of experienced nurses demonstrate a smaller number of patient falls.

**Nursing human capital and RN recruitment and retention.**

Over the last several years professional organizations and licensing bodies have attempted to address the issue of quality work environments for nurses. Several reports commissioned by
these groups have led to the development of practice guidelines and policy recommendations necessary for the achievement of quality work environments for nurses and the provision of quality patient care (Registered Nurses' Association of Ontario [RNAO], 2006; Lowe, 2002). CPD opportunities for nurses have been identified by professional organizations as necessary for the creation of quality work environments for nurses (CNA, RNAO). Eleven empirical papers linking CPD and the recruitment and retention of RNs were incorporated into the review.

The literature reporting on the effects of magnet hospitals provides some evidence of a link between CPD and successful recruitment and retention of RNs (Aiken et al., 2000; Kramer & Schmalenberg, 2004b; Upenieks, 2002, 2003b). Magnet Hospitals promote professional practice environments by instilling support for education, clinically competent nursing staff, strong nurse-physician relationships, autonomous nursing practice, a culture that values concern for the patient, control of and over nursing practice, perceived adequacy of staffing, and nurse-manager support (Kramer & Schmalenberg). Nurses have identified these attributes as being essential for their job satisfaction and quality patient care and thus promote the retention and recruitment of qualified RNs. In an effort to better understand what nurses mean by educational support, Kramer and Schmalenberg conducted a follow-up study of RNs from magnet hospitals, aspiring magnet hospitals and RNs that do not work in either type of setting. Using a two-pronged approach of interviews and questionnaires the researchers determined that RNs employed in Magnet-hospitals report that they have more access and greater financial assistance to attend CPD programs, and work with others that value education, than RNs who do not work in Magnet Hospitals (Kramer & Schmalenberg).

Nurses identify access and support for CPD as positive strategies for recruitment and retention (Fletcher et al., 2004; Nolan et al., 2000). In a survey of 1500 clinical nurses and 290 nurse managers in England, CPD opportunities were identified as being essential for the recruitment and retention of RNs (Nolan et al.). Fletcher surveyed RNs (N = 4,575) within the State of California related to their job satisfaction. RNs identified (a) tuition reimbursement for degrees and continuing education, (b) orientation to new RN jobs, (c) employer-sponsored training programs, and (d) the availability of programs to facilitate their
transition to a new job as major contributors to their job satisfaction. The study did not investigate if RNs who received these CPD initiatives had higher job satisfaction or greater organizational tenure. Determining if nurse access to employer sponsored CPD increases the nurses’ job satisfaction and results in the retention of RNs would provide organizations with empirical evidence that could be used to support fiscal decision-making related to the CPD of nurses within hospitals.

Additionally, Sechrist and Lewis (2004) surveyed 490 health care agencies within the State of California regarding the practices they employ to recruit and retain RNs. Over one half of the health care agencies surveyed reported support of nursing education as a method employed to recruit RNs. Most of the respondents indicated they used financial assistance for baccalaureate or advanced degree education (80%) and growth opportunities such as in-service education (100%), as strategies to retain RNs. However the recruitment and retention strategies employed by these hospitals were not associated with their nurse orientation costs or rates of RN retention, turnover or vacancies. It therefore remains unclear how investing in these strategies benefit hospitals. Further research is required to determine if there is an empirical link between organizational investment in recruitment and retention strategies and their relationship to the recruitment and retention of RNs.

Findings from the two studies conducted in California are similar to those identified by The Nursing Sector Study conducted in Canada (O’Brien-Pallas et al.; 2005c). Nurses surveyed in this study also identified access to CPD activities as an important factor that influences their job satisfaction. The perceptions of the nurses were confirmed by Senior Nurse Managers throughout Canada who reported that organizations with higher levels of support for CPD had higher levels of retention of RNs with 5 years or greater organizational tenure ($p < .01$: O’Brien-Pallas et al., 2004). However, the researchers did not examine the relationship of employer sponsored CPD to orientation costs or the organization’s vacancy and turnover rates. Despite an established link between employer sponsored CPD and high nurse retention of experienced RNs, the relationship of nurse staffing to the knowledge, skills and experience of nurses within these environments and their relationship to the recruitment and retention of RNs has not been determined.
Several authors documented outcomes related to CPD programs and the recruitment and retention of nurses through results of CPD program evaluation. Although the results cannot be generalized beyond the particular settings in which the programs were delivered, and are limited by small sample sizes, they do provide an insight into the goals, objectives and program outcomes related to educating RNs after they enter the profession. Using various theoretical frameworks or evaluation models the authors demonstrated improvements in recruitment and retention outcomes including the reduction in overtime, agency staff and sick time usage (Allan & Cornes, 1998), and decreased turnover and increased retention of new hires (Baggot, Hensing, Parry, Valdes & Zaim, 2005; Beecroft, Kunzman & Krozek, 2001). However, these studies did not explain if the work environment contributed to outcome achievement and therefore the replication of their findings may be difficult as factors within the work environment differ among nursing units and hospitals.

Despite accumulating evidence that CPD can enhance the retention of RNs there are very few studies that investigated the relationships among investing in the knowledge and skills of RNs, the work environment and specific recruitment and retention outcomes. The magnet hospital prevention model, published by Upenieks (2003a) outlines the potential benefits for organizations to invest in RNs’ knowledge and skills after the nurse enters the profession. Upenieks argues that investing in adequate orientation programs, providing financial assistance for nurse CPD, along with appropriate nurse-patient ratios, and nurse participation in decision-making will reduce nurse turnover and its associated costs such as new hire orientation and agency use. A study designed to capture the relationship among employer sponsored nurse CPD and recruitment costs, and vacancy, retention and recruitment rates would provide organizations with evidence to support the establishment of educational programs and resources to support the CPD of nurses.

**Nursing human capital and characteristics of the work environment.**

Characteristics of the work environment that have been identified as possibly affecting the knowledge and skills RNs acquire from CPD include employer support for nurse CPD and nurse staffing. Seven studies were found that describe the relationships between the factors within the work environment and the knowledge, skills and experience of RNs.
Nursing human capital and employer support for nurse CPD.

Magnet hospital staff nurses and nurse executives agree that educational support is necessary not only for the recruitment and retention and job satisfaction of RNs but also for ensuring high quality patient care (Kramer & Schmalenberg, 2004a). Nurses identify the lack of employer support for addressing their learning needs after they enter the profession as a significant obstacle that prevents them from developing their knowledge and skills (CNAC, 2002). Funding for CPD in the form of registration fees, academic tuition and salary for time off to learn have been identified as instrumental in assisting nurses with updating their knowledge and skills (Hughes, 2005; Kiener & Hentschel, 1989; Kramer & Schmalenberg, 2004a; Nolan et al., 1995; Scheller, 1993; Smith, 2004). Smith found that 60% of RNs (N = 2000) and 50% of LPNs (N = 2000) report being financially reimbursed for expenses related to CPD. Approximately 18% (N = 200) of nurses in the study by Hughes indicated that employer subsidization was a reason they decided to participate in CPD.

Although there are several small studies that have investigated the effects of specific educational programs on professional behavior changes or the quality of patient care, there is limited evidence of a direct relationship between employer sponsored nurse education and the quality of patient care. However, a possible relationship between these two variables was identified by Waddell (1992). In a meta-analysis, Waddell found greater changes in professional practice behaviors occurred when nurses were from the same work setting than when they were from multiple settings. Therefore it may be speculated that, when employers support opportunities for their employees to learn together, social networks occur; this then creates the conditions necessary for knowledge exchange, which contributes to the development of staff collective knowledge on the inpatient unit. Although this finding does not demonstrate a direct relationship between employer-supported CPD and the quality of patient care, it suggests a possible link between employer support for CPD, professional behavior changes of a group and improvements in the quality of patient care.

Despite the perception that the quality of patient care is superior in hospitals that invest in the knowledge and skills of their nurses, there is limited empirical evidence to support this proposition. A study that investigates the relationship between employer-sponsored CPD and
the quality of patient care at the unit-level would provide evidence to support the perceptions of nurses and managers that CPD is necessary if safe and good quality patient care is to be achieved.

**Nurse staffing and nursing human capital.**

Adequate staffing has been identified by RNs working in Magnet hospitals as being essential for nurses to provide good quality patient care (Kramer & Schmalenberg, 2004b). Nursing units that are short staffed are not able to permit RNs time away from the unit to learn or to share what they have learned with their colleagues. RNs have identified the need to be replaced when they are permitted time away from the unit to learn so that they do not leave the unit short-staffed thereby jeopardizing the quality of care and patient safety (CNAC 2002).

The proportion of RNs to total nursing staff and skill-mix have been found to be inversely related to patient safety outcomes or adverse events (Carter, 2000; Kovner & Gergen, 1998; Blegen & Vaughn, 1998; McGillis Hall, Doran, & Pink, 2004; Tourangeau et al., 2007). However the relationship of nurse staffing to knowledge and skills acquired from CPD and nurse experience have not been investigated.

RNs have expressed difficulty participating in CPD if their workload is too high, if they are overworked or if staffing is insufficient (Kiener & Hentschel, 1989; Scheller, 1993). Kiener and Hentschel while investigating the effects of a workshop on practice, asked nurses to identify facilitators and hindrances to introducing new ideas into practice. They found that 24% of the nurses (N = 443) identified workload or lack of time as a barrier that prevented them from making practice changes post workshop. Fifteen percent of the nurses also identified lack of administrative support and resources, such as funds for travel or access to consultants, as preventing them from integrating new ideas into practice.

Using a qualitative design, Scheller (1993) interviewed 8 RNs from a community hospital to identify the factors within the work environment that influence their use of knowledge acquired from CPD. The most prevalent theme identified by the nurses was inadequate time. The nurses described “lack of time” as “[the amount of time] it takes to accomplish patient
care activities, taking into consideration the workload and staffing of the nursing unit” or “to not be able to get away from the unit due to limited staffing and high patient workload” (p. 118). Limited by its small sample size this study provides preliminary evidence of nurses’ perception of work environmental factors and their potential influence on the application of knowledge and skills acquired from CPD.

Foglesong et al. (1987) investigated the effects of a workshop on analgesia administration within a university and a community hospital. They found that nurse-patient ratio and skill-mix may have had an influence on the percentage of patients receiving analgesia post workshop. Foglesong et al. reported the percentage of patients who received analgesia after the workshop increased the most at the community hospital (13%, $n = 32$) on the shift that had the highest nurse-patient ratio (1:9) and on shifts that had a skill-mix with higher percentage of professional nursing staff versus ancillary staff caring for patients (29-30%). At the university hospital the percentage of patients receiving analgesia stayed the same (70%, $n = 32$) after the workshop on the day shift when the nurse-patient ratio was 1:5 and the skill-mix was 86% RN and LPN. The percentage of patients receiving analgesia increased from 50% to 60% on the evening shift when the nurse-patient ratio was 1:7 and the skill-mix was composed of 60% professional. A 42% ($n = 32$) increase in the number of patients receiving analgesia was reported when the nurse-patient ratio was 1:9 and the skill-mix was composed of 50% professional nursing staff. Unfortunately the researchers did not examine the difference in the percentage of patients receiving analgesia between the two hospitals, the relationship between staffing variables and the rate of analgesia administration, or the amount of change in the percentage of patients who received analgesia prior to and after the intervention. These analyses would have enabled the researchers to determine if there was a relationship between skill-mix and the rate of analgesia administration or if there was a significant change in the percentage of patients who received the analgesia post intervention. Despite these limitations the study findings introduce the possible relationship among nurse staffing, the knowledge and skills acquired from CPD, and the changes in professional practice behavior that can influence the quality of patient care.
Nurse staffing has been operationally defined and measured in various ways including (a) ratio of RN to total nursing staff or skill-mix, (b) proportion of RNs, registered practical nurses (RPNs) and unlicensed workers, or skill-mix, and (c) total hours utilized for direct patient care per patient day. Nurse staffing has been found to be inversely related to adverse events including (a) falls (Blegen & Vaughn, 1998b; Dunton, Gajewski, Taunton & Moore, 2004), (b) injury from falls (Carter, 2000), (c) medication errors (Blegen et al.; McGillis Hall et al., 2004), (d) pneumonia and urinary tract infections following major surgery (Kovner & Gergen, 1998), (e) thrombosis and pulmonary compromise following major surgery (Kovner & Gergen), (f) wound infections (McGillis Hall et al.), (g) patient mortality (Aiken et al., 2002; Estabrooks et al., 2005; Tourangeau et al., 2007), and (h) failure-to-rescue (Aiken et al.). However, Potter et al. (2003) found no significant correlation between the percentage of RN hours and falls or medication errors. Thus the literature indicates inconsistent findings between nurse staffing and adverse events due to the variation in research designs, methods and analyses used to test the relationships, as well as levels of analysis (Lankshear, Sheldon & Maynard, 2006).

**Nursing structural capital and the quality of patient care.**

Practice guidelines are an example of a structure that contains nursing knowledge. A review of the literature was conducted to identify empirical literature to support the proposed relationship between practice guidelines and quality of patient care. The following search terms were used: nursing protocols, clinical guidelines, and care maps in nursing. These search terms were then reentered in combination with patient falls, medication errors and hospital-acquired infections. Review of the indices and abstract databases included the Cumulative Index to Nursing Allied Health Literature, Index Medicus and HealthStar. The search resulted in twelve empirical resources that are incorporated in this review.

The use of practice guidelines for the development of nursing practice has become more common in recent years. Other terms used to denote practice guidelines include best practice guidelines, clinical pathways, protocols, practice policies, and clinical policies (Estabrooks et al., 2005). The implementation and use of practice guidelines are believed to benefit both patients and nurses (Ring et al., 2005). The benefits to nurses include (a) facilitation of the
delivery of patient care, (b) increase in knowledge, (c) promotion of practice changes, (d) increased accountability, and (e) use of research findings in practice (Miller et al., 2004; Ring et al.). Benefits to patients include the improvement in the quality of care, and increased availability of information related to their medical condition (Miller; Ring et al.).

Evidence related to the effects of nursing practice guidelines on the quality of patient care is emerging. In a systematic review of 18 studies, Thomas et al. (2002) determined that the use of practice guidelines or protocols for the delivery of nursing care can positively affect patient outcomes; however they cautioned readers of the limited generalizability of the findings to other settings due to small sample size, the implementation of the guidelines at one site, and methodological errors related to the level of analyses. The implementation of practice guidelines by nurses have been reported to be effective in reducing the incidence of incontinence in long term care patients, (Frantz, Xakellis, Harvey, & Lewis, 2003), occurrence of pressure ulcers (Frantz, Gardner, Specht, & McIntire, 2001; Frantz et al.), rate of hospital-acquired ventilator-assisted pneumonia (Salahuddin et al., 2004), rate of paralytic ileus in post-operative patients (Madsen et al., 2005), severity of injuries from falls (McCarter-Bayer et al., 2005), rate of patient falls (Mitchell & Jones, 1996), severity of pain (Dufault et al., 2000), and length of stay (Gill et al., 1994). Recently, Canadian researchers studying mortality rates of hospitalized medical patients found higher use of care maps or protocols to guide patient care was significantly associated with lower 30-day mortality rates ($F = 11.88; p \leq .001$: Tourangeau et al., 2007).

No studies could be located investigating the relationship of using nursing practice guidelines to the rate of hospital-acquired infections or medication errors by nurses. Mitchell and Jones (1996) used a pretest post-test design to investigate the effect of an intervention to reduce the fall rate of patients on a unit within an acute care hospital. The intervention included a protocol designed to prevent patient falls. Although there was a reduction in the fall rate at post-test, the mean differences were nonsignificant at the $p \leq .05$ level ($t = 1.744, df = 10, p = .055$). It should be noted that interventions designed to reduce the rate of falls and injuries from falls within acute care hospitals have been tested (Mitchell et al.; McCarter-Bayer et al., 2005). Often the interventions include risk assessment and fall and injury prevention
strategies; however findings from these studies do not determine if the use of risk assessment and fall prevention strategies significantly reduce the rate of patient falls. Instead the use of interventions that comprise risk assessment and fall and injury prevention strategies have been found to be successful in reducing patients’ risk of falling. It therefore remains necessary to determine if the availability of practice guidelines, protocols and care maps for the prevention of patient falls significantly reduce the rate of patient falls within acute care hospitals. In addition, the relationships between fall and injury prevention strategies and the rate of patient falls within acute care hospitals would be further elucidated if the association between nurse staffing and rate of patient falls was analyzed (Currie, 2006). By investigating the relationship of other variables within the work environment, such as nurse staffing or the knowledge, skills and experience of the unit’s nursing staff would provide additional evidence related to the conditions under which nursing practice guidelines, protocols and care maps affect the rate of falls within acute care hospitals.

The contribution of using practice guidelines, protocols and care maps by nurses for the prevention of patient falls, medication errors or hospital-acquired infections to the rate of the same adverse events has not been determined. The absence of studies investigating the effects of practice guidelines, protocols or care maps on the quality of patient care reinforces the need for such studies. Determining if the availability of nursing structural capital in the form of practice guidelines, protocols or care maps to nurses affect the quality of patient care as measured by the rate of adverse events of patient falls, hospital-acquired infections and medication errors will provide clinicians, managers, researchers and educators with evidence to continue to support their continuous development and use with the goal of improving patient care and outcomes.

**Nursing Intellectual Capital Theory-Operational and Empirical Definitions.**

Operationalization of the concepts in the form of observed variables and empirical indicators is necessary in order to allow for their measurement and the investigation of their association with other concepts. A concept is a component of a theory that describes an idea, phenomenon, event, thing, or action (Walker & Avant, 2005). When a concept is defined operationally it becomes a variable that can be measured and studied (Walker & Avant). The
operational definitions of concepts in the middle-range theory of nursing intellectual capital were derived from a review of pertinent nursing literature. The review included a search utilizing key words related to the potential outcome variables (Cooper, 1998). The search terms included patient outcomes, patient safety, patient morbidity and mortality, falls, medication errors, infections, costs, productivity, recruitment, retention, turnover, workload, and staffing in nursing. These search terms were then reentered in combination with continuing education, continuing professional development, continuing professional education, academic education, specialty certification and experience in nursing. Review of the indices and abstract databases included: Cumulative Index to Nursing and Allied Health Literature, Dissertation Abstracts International, and Index Medicus. Reports from national, provincial and state regulatory and professional bodies and individual journals and hand searches were also performed. Appendix A includes the study variables, their operational definitions, and empirical definitions and indicators.

Nursing human capital includes the attributes of knowledge and skills (acquired through participation in continuing professional development such as continuing education activities, specialty certification, and academic preparation) and experience (years of professional experience, years of experience in the clinical specialty, and years of unit tenure) of the unit’s registered nursing staff.

a. Continuing education (CE) was operationally defined as the formal learning that takes place after the nurse enters the profession. CE activities includes conferences, workshops, in-services, university courses, and short programs (ANA, 2002; CNA & CASN, 2000; O'Brien-Pallas et al., 2004). University courses include those taken by RNs for academic credit. Short programs include ongoing learning opportunities that are short in duration and take place within the hospital. CE was empirically defined as the number of hours of CE (continuing education such as conferences, workshops, in-services, university courses and short programs) attended by unit’s RNs.

b. Specialty certification was operationally defined as the formal recognition by an organized professional body of the specialized knowledge, skills, and experience of an RN. Specialty certification confirms that a registered nurse has met predetermined
standards of competency in a nursing specialty, such as oncology, as identified by a nursing professional organization (American Board of Nursing Specialties, 2006; CNA, 2007). Specialty certification was empirically defined as the proportion of RNs on an inpatient unit with certification.

c. Academic preparation was operationally defined as the knowledge acquired from the highest academic degree held in nursing. Academic preparation was empirically defined as the proportion of RNs on an inpatient unit with university degrees.

d. Nurse professional experience was operationally defined as the experience a nurse has received since licensure. Nurse professional experience was empirically defined as the unit’s mean RN professional experience.

e. Nurse clinical specialty experience was operationally defined as the experience a nurse has from working in the clinical specialty of the unit. Nurse clinical specialty experience was empirically defined as the unit’s mean RN clinical specialty experience.

f. Nurse unit tenure was operationally defined as the experience a nurse received from working on the unit. Nurse unit tenure was empirically defined as the unit’s rate of RN tenure (length or service to the unit).

Nursing structural capital refers to the material resources that are comprised of nursing knowledge and are used to support the work of RNs by facilitating the application of their knowledge, skills and experience to the delivery of quality patient care (Miller et al., 2004).

a. Nursing structural capital was operationally defined as the availability of care maps, practice guidelines, and protocols that provide evidence-based information related to the care of patients. Nursing structural capitals was empirically defined as the availability of practice guidelines, protocols or care maps for the prevention of patient falls, medication errors and/or hospital-acquired infections.

Nurse staffing reflects the supply of RNs and mix of nurses available who have the knowledge and skills to competently meet the care needs of patients on the unit (Miller et al.,
The relationship between nurse staffing and outcomes has been found to be most direct at the level of the inpatient unit (Blegen, 2006). Using unit-level analysis of nurse staffing recognizes that nurse staffing decisions are made at the level of the patient unit (Blegen) providing the most direct effect of nurse staffing on the unit rate of patient falls, medication errors and hospital acquired infections. The attributes of the nurse staffing concept are hours per patient per day (HPPD), skill-mix and RN-to-patient ratio of the unit.

a. HPPD was operationally defined as the number of nursing hours utilized for direct patient care per patient day. Direct patient care hours exclude hours used for benefits, orientation, or education hours and includes the many tasks that nurses do on behalf of the patient in an effort to assist patients with meeting basic human needs (O’Brien-Pallas et al., 2005a). Direct patient care entails activities such as assisting patients with feeding, drinking, positioning, ambulating, grooming, toileting, dressing and socializing as well as collecting, reporting and documenting data related to these activities (ANA, 2006). HPPD was empirically defined as the number of unit inpatient care hours used per patient per day.

b. Skill-mix was operationally defined as the proportion of RN hours to nursing staff hours. Skill-mix was empirically defined as the proportion of unit hours accounted to RNs.

c. RN-to-patient ratio was operationally defined as the number of patients cared for by one registered nurse. RN-to-patient ratio was empirically represented by the mean number of patient cared for by one RN per shift days, evenings and nights over a 24-hour period.

Support for nurse CPD is a set of human and fiscal behaviors that demonstrate the organization’s values related to nurse education. The attributes of the employer support of CPD concept are financial assistance for CPD, time off to learn (Kramer & Schmalenberg, 2004c), provision of replacement staff and the availability of clinical nurse educator and/or consultant support on the unit.
Financial assistance was operationally defined as funding provided by the organization in the form of bursaries, scholarship, tuition reimbursement or registration fees for RNs to attend CPD activities. Financial assistance was empirically defined as the proportion of RN that received funding from the hospital to attend CPD.

Time off to learn was operationally defined as time off (paid and unpaid) employers give to RNs to attend CPD. Paid time off to learn was operationally defined as paid time off given to the RN to attend CPD. Paid time off to learn was empirically defined as the number of inpatient hours used for RNs to learn. Unpaid time off to learn was operationally defined as the unpaid time off given to RN to attend CPD. This includes unpaid time off to attend CPD, courses, conferences, certification, short programs, in-services, as well as, unpaid study leaves. Unpaid time off was empirically defined as the number of unpaid hours allocated for RNs to learn.

Replacement staff was operationally defined as replacing the RN with a RN of comparable knowledge, skills and experience while away from the unit to attend CPD. Replacement staff was empirically defined as the percentage of time RNs are replaced when they are away from the unit to learn.

Clinical nurse educator or consultant was operationally defined as the clinical nurse educators or consultants to support unit RNs with clinical decision-making and provide education. Clinical nurse educator or consultant was empirically defined as the ratio of clinical educator-to-RN.

Quality of patient care was operationalized through the rate of adverse events that occur on the unit. The adverse events measured for this study are patient falls, hospital-acquired infections and medication errors.

A patient fall was operationally defined as an unintended event resulting in a person coming to rest on the ground/floor or other lower level (witnessed), or is reported to have landed on the floor (non-witnessed) not due to any intentional movement or extrinsic force such as stroke, fainting, or seizure (RNAO, 2002). Patient falls was empirically defined as the unit rate of patient falls.
b. A hospital-acquired infection was operationally defined as an infection for which there is no evidence that the infection was present or incubating at the time the patient was admitted to the hospital facility. Hospital-acquired infections include C-Difficile, MRSA and VRE laboratory confirmed infections that occurred 24 hours after the patient was admitted to the hospital. Hospital-acquired infection was empirically defined as the unit rate of hospital-acquired (C-Difficile, MRSA and VRE) infections.

c. A medication error was operationally defined as the incorrect administration of a drug, either in dose, timing, patient identification or drug identification that did or did not harm the patient. Medication error was empirically defined as the unit rate for medication errors.

Recruitment and retention outcomes are fiscal and statistical rates related to the recruitment and retention of RNs. They include the proportion of RN hours used for orientation hours, recruitment rate, vacancy rate, and turnover rate.

a. RN orientation hours was operationally defined as the number of hours used for newly hired RNs to be oriented to the hospital and unit. RN orientation hours were empirically defined as the proportion of unit earned hours used for RN orientation.

b. Recruitment rate was operationally defined as the proportion of RN FTE positions hired (filled) within the last year (Upenieks, 2003a). Recruitment rate was empirically defined as the unit rate for RN recruitment.

c. Vacancy rate was operationally defined as the proportion percent of unit RNs FTE positions unfilled or vacant (Upenieks, 2003a). Vacancy rate was empirically defined as the unit rate for RN vacancy.

d. Turnover rate was operationally defined as the proportion of unit RN FTE positions voluntarily vacated by resignations from the hospital or transferring to another unit (Capuano et al., 2005). Turnover rate was empirically defined as the unit rate for RN turnover.
Study Hypotheses

The hypotheses tested were derived from the middle-range theory’s propositions related to the concepts of nursing human and structural capital, factors within the work environment, and the selected outcomes.

Hypothesis 1: Nursing units with high levels of nurse staffing will have high levels of human capital, which in turn, will have high levels of quality of patient care and high recruitment and retention outcomes.

H1a. Nursing units with high levels of nurse staffing (hours per patient per day, skill-mix, RN-to-patient ratio) will have high levels of registered nurse participation in CPD (number of hours of RN participation in CE) and large number of RNs with high (university level: BSN degrees or higher) academic preparation, experience, tenure, and specialty certification.

H1b. Nursing units with high levels of human capital (registered nurse: participation in CE, specialty certification, academic preparation, experience, tenure) will have high quality patient care (low rates of patient falls, medication errors and hospital-acquired infections).

H1c. Nursing units with high levels of human capital (registered nurse: participation in CE, specialty academic preparation, experience, tenure) will have high recruitment and retention of RNs (low RN orientation hours, vacancy and turnover rates of RNs, and high RN recruitment).

Hypothesis 2: Nursing units with high levels of employer support for nurse CPD (time off to learn, financial assistance, replacement staff, ratio of clinical educator-to-RN clinical nurse educators or consultants to RN FTEs) will have high levels of human capital, which in turn, will have high levels of quality of patient care and high RN recruitment and retention.

H2a. Nursing units with high levels of employer support for nurse CPD will have a high percentage of RNs with degrees and specialty certification that participate in a high number of hours of CE, have high number of years of professional experience and unit tenure.
H2b. Nursing units with high levels of human capital (registered nurse: participation in CE, specialty certification, academic preparation, experience, tenure) will have low rates of patient falls, medication errors and hospital-acquired infections.

H2c. Nursing units with high levels of human capital (registered nurse: participation in CE, specialty certification, academic preparation, experience, tenure) will have low RN orientation hours, high RN recruitment and low RN vacancy and turnover rates.

Hypothesis 3: Nursing units with high levels of structural capital (availability of care maps, protocols and practice guidelines) will have high levels of quality of patient care (low rates of patient falls, medication errors and hospital-acquired infections).

Summary
In summary, this chapter presented the theory of intellectual capital and its derivation to nursing. The middle-range nursing intellectual capital theory and its concepts, nursing human and structural capital, related antecedents of nurse staffing and employer support for nurse CPD and their proposed relationships to outcomes of quality of patient care and the recruitment and retention of RNs were presented. The theory propositions, operational and empirical definitions, and study hypotheses were also provided. This chapter also presented a review of the empirical literature supporting the study propositions and hypotheses. Results from the review indicate there is limited empirical evidence of the contribution of nurses’ knowledge, skills and experience to the quality of patient care and the recruitment and retention of RN signifying a need for further research in this area. In addition, investigation of the relationship of the work environment, specifically nurse staffing and employer support for nurse CPD and their association to the knowledge and skill development of RNs is required. A better understanding of the relationship of nurses’ knowledge, skills and experience to the quality of patient care and its association with the recruitment and retention of RNs will provide administrators and educators with evidence related to their decision-making for budget allocation and program planning, respectively.
Chapter 3
Research Methodology

The purpose of the study was to empirically test the propositions of the middle-range nursing intellectual capital theory and its ability to determine under what conditions the nurses’ knowledge, skills and experience are associated with the quality of patient care and RN recruitment and retention within acute care hospitals. In this chapter the research design including the setting and sample, description of the empirical indicators, procedures for data collection, statistical analysis and protection of human subjects are discussed.

Design
A descriptive-correlational cross-sectional design was used to determine the hypothesized direct and indirect associations of nursing human capital to the quality of patient care and RN recruitment and retention. Data were collected from two sources (a) hospital databases, and (b) a short survey of unit managers. The 23 study variables were assessed for their occurrence at the hospital inpatient unit-level within a fiscal year.

Setting
The study took place at acute care hospitals in Ontario and Quebec, Canada. Thirteen acute care hospitals in the two provinces accessible to the researcher were approached to participate in the study. The researcher contacted the Chief Nursing Officer (CNO) within each hospital by email or telephone to request a meeting to describe the study. At the meeting, the researcher explained the study and inquired about initial interest in taking part in the study. The 13 hospitals indicated initial interest and willingness to provide the data.

Acute care hospitals in Ontario and Quebec provide a variety of patient care services. The type of patient care services include highly specialized care (trauma, critical care, maternal child, psychiatry, and pediatrics), general medical-surgical care, long-term care, complex continuing care and ambulatory care (Canadian Healthcare Association, 2009).

Sample
Acute care inpatient units were targeted in this study. An inpatient unit was defined as an independent cost center that provides patient care to hospitalized patients. Medical, surgical,
obstetric, pediatric, psychiatric, adult critical care, long term-complex continuing care units with a patient length of stay of greater than 24 hours were eligible to participate in the study. Units were excluded if they had a length of stay less than 24 hours, such as emergency rooms, day surgery, ambulatory services, operating and recovery rooms because they were not able to provide relevant data on the hospital-acquired infections. Units were also excluded if they provided care to neonates or children under the age 2 years such as, neonatal and pediatric critical care units, and newborn nurseries because they were not be able to provide meaningful data on patient falls.

To provide a brief description of the study’s sample, characteristics of hospitals that participated in the study were obtained from hospitals’ public websites and then verified by the study contact person at the participating hospital: (a) hospital location, (b) number of beds, and (c) academic affiliation. Characteristics of the inpatient units were collected via the unit manager survey (Appendix B) and included: (a) number of patient beds, (b) type of unit, (c) average patient length of stay, and (e) average age of the nursing staff.

The sample size was established using the criteria for structural equation modeling (SEM) of 8 participants per variable (Schumacker & Lomax, 2004). Applying the criterion (i.e. 8 participants per variable x 23 variables) resulted in a total sample size of 184 inpatient units. Although researchers report sample size calculations between 5-10 participants per variable as sufficient to establish model fit, others report a good sample size when using SEM should be between 100-200 participants (Schumacker & Lomax). A sample size of 100-200 is recommended as the chi-square statistic has been found to be sensitive to sample size. Since a nonsignificant chi-square statistic is often used to determine model fit, a sample size below 100 can lead to an erroneous nonsignificant chi-square. Conversely, a sample size above 200 can lead to erroneous significant chi-square. Thus if the sample size is too small or large it can lead to inaccurate conclusions of model fit (Schumacker & Lomax). Therefore a sample size of 184 inpatient-care units was required to allow for accurate determination of model fit. Through meeting with CNOs of Quebec and Ontario hospitals it was determined that it was feasible to collect data on 184 inpatient units within the time frame allocated for this study. In order to assure complete data from the required number of units, 221 inpatient units were
targeted for recruitment. The oversampling allowed for 20% missing or incomplete data, and an 80% response rate.

**Variables**
The middle-range nursing intellectual capital theory (Figure 2) includes 4 concepts (nurse staffing, employer support for nursing, nursing human capital, nursing structural capital) and 7 outcome variables, (patient falls, hospital-acquired infections, and medication error rates, proportion of hours used for RN orientation, and RN turnover, RN recruitment and RN vacancy rates). The concepts and variables were determined after a critical review of the nursing literature. The variables’ operational definitions and empirical definitions were discussed in Chapter 2, and are summarized with the empirical indicators in Appendix A.

The work of Doran (2001), Edvinsson and Malone (1997), Lankshear, Sheldon and Maynard (2005), McGillis Hall (2003); McGillis Hall et al. (2001; 2004) and Stewart (1997; 2001) were used to define the variables. If a variable could not be defined and measured accurately or comprehensively by using a previously published empirical indicator, a new one was developed. The following section presents the method with which the variables were measured and how the data were obtained. All data were collected per unit for the fiscal year 2007-2008.

**Nurse staffing variables.**
The concept of nurse staffing was operationalized by its three indicator variables: (a) hours per patient day, (b) skill-mix, and (c) registered nurse-to-patient ratio.

a. Hours per patient day was measured as the total inpatient worked hours (excluding hours for benefits) used for all unit staff (including purchased hours for float and agency staff or sitters) assigned to a unit per patient day. The total inpatient worked hours were divided per patient days. The total inpatient hours and the total patient days for the unit were obtained from the hospital’s financial department database.

b. Skill-mix or the proportion of RN earned hours (including benefits and purchased hours) to total earned hours. Total earned hours were those related to RN, RPN and nonprofessional nursing staff (i.e., sitters or unregulated workers) as well as
purchased hours for float nursing staff. Skill-mix data were obtained from the hospital’s financial department database.

c. RN-to-patient ratio was measured as the mean number of patients per RN. RN-to-patient ratio was empirically represented by the mean number of patients cared for by one RN per shift for days, evenings and nights over a 24-hour period. Pertinent data were collected from the unit manager survey.

**Employer support for nurse CPD variables.**
The concept of employer support for nurse CPD was operationalized with four indicator variables. They included (a) financial assistance to attend CPD, (b) time off to learn, (c) replacement for RNs away from the bedside to learn, and (d) the availability of clinical nurse educators or consultants.

a. Financial assistance to attend CPD was measured as the number of RNs who received financial assistance to attend CPD per the total number of RNs. The number of RNs who received financial assistance was obtained from the unit manager survey and the number of RNs was received from the hospital’s human resource department database.

b. Time off to learn was measured as the sum of paid time off to learn and unpaid time off to learn. Paid time off to learn was measured as the number of RN earned hours allocated to RNs for time off to learn divided by the total inpatient earned hours. Paid time off to learn was obtained from the hospitals’ financial database. Unpaid time off to learn was measured as the number of unpaid hours allocated for RNs to learn divided by the total number of RNs. The number of unpaid hours to learn was obtained from the unit manager survey and the number of RNs was obtained from the hospital’s human resource department database.

c. Replacement staff was measured as the percent of time RNs were replaced while they were away from the unit to attend CPD activities. Information on replacement staff was obtained from the unit manager survey.
d. Ratio of clinical educator-to-RN was measured as the number of budgeted FTE educator or consultant positions allocated to the unit per total number of RN FTE budgeted positions. The number of FTE educator or consultant positions was obtained from the unit manager survey. The number of RN FTE budgeted positions was obtained from the hospital’s human resource department database.

**Nursing human capital variables.**

Nursing human capital concept was operationalized with six indicator variables including the RNs’ (a) academic preparation, (b) participation in CE, (c) specialty certification status, (d) professional experience, (e) clinical specialty experience, and (f) unit tenure.

a. Nurse academic preparation was measured as the proportion of the RNs with degrees (bachelor’s degree or higher). Nurse academic preparation was obtained from the unit manager survey.

b. Participation in CE was defined as the number of hours of CE activities including conferences, workshops, in-services, university courses, and short programs attended by all RNs. RN participation in CE was obtained from the unit manager survey.

c. Specialty certification was measured as the proportion of RNs with specialty certification. The number of RNs with specialty certification was obtained from unit manager survey and the number of RNs was obtained from the hospital’s human resource department database.

d. Professional experience was measured as the mean number of years of RN professional experience. Professional experience was obtained from hospital’s human resource department database.

e. Clinical specialty experience was measured as the mean number of years of RN clinical specialty experience. Clinical specialty experience was obtained from the unit manager survey.
f. RN unit tenure was measured as the mean number of years the RNs have been employed by the unit. RN unit tenure was obtained from the hospital’s human resource department database.

**Nursing structural capital variables.**
Nursing structural capital concept was measured as the availability of practice guidelines, protocols or care maps for the prevention of adverse events including patient falls, medications errors, and hospital-acquired infections. The availability of practice guidelines, protocols or care maps for the prevention of adverse events was obtained from the unit manager survey.

**Quality of patient care outcome variables.**
Quality of patient care was represented with three outcome variables including the rates of patient falls, hospital-acquired infections, and medication errors. All of the participating units used incident reports to voluntarily report patient falls and medication errors. The hospital-acquired infections were those infections that had clinical and laboratory confirmation from the infection control department.

a. The fall rate was measured as the number of voluntarily reported patient falls with or without injury per 1,000 patient days. It was obtained from the hospital’s risk management database.

b. The hospital-acquired infection rate was measured as the total number of clinically and laboratory confirmed C-Difficile, MRSA and VRE infections combined per 1,000 patient days. The unit rate of hospital-acquired infections was obtained from the hospital’s infection control database.

c. The medication error rate was measured as the number of voluntarily reported medication errors per 1,000 patient days. The medication error rate was obtained from the hospital’s risk management database.

**RN recruitment and retention outcome variables.**
RN recruitment and retention outcomes were reflected in three outcome variables including RN orientation hours, RN recruitment rate, RN vacancy rate, and RN turnover rate.
a. RN orientation hours was measured as the proportion of unit hours used as orientation hours for newly hired RNs. It was calculated as the number of RN earned hours used for orientation divided by RN inpatient earned hours. The number of RN earned hours used for orientation and the total number of RN inpatient earned hours were obtained from the hospital’s financial department database.

b. RN recruitment rate was measured as the proportion of budgeted RN full time equivalent (FTE) positions used for newly hired RNs (Upenieks, 2003a). It was calculated as the number of newly hired RN FTEs divided by the total number of budgeted permanent RN FTE positions. The number of newly hired RN FTEs and budgeted RN FTE positions were obtained from the hospital’s human resource department database.

c. RN vacancy rate was the proportion of vacant budgeted RN FTE positions (Upenieks, 2003a). It was calculated as the number of vacant budgeted RN FTE positions divided by the total number of budgeted permanent RN FTE positions. The number of vacant budgeted RN FTE positions and budgeted RN FTE positions were obtained from the hospital’s human resource department database.

d. RN turnover rate was the proportion of budgeted RN FTE positions that voluntarily separated from the unit (Capuano et al., 2005). It was calculated as the number of budgeted RN FTE positions that were vacated divided by the total number of budgeted RN FTE permanent positions. A position was considered voluntarily vacated when the RNs quit or transferred (excluding retirements) to another unit. The numbers of budgeted RN FTE positions that voluntarily separated from the unit and budgeted RN FTE positions were obtained from the hospital’s human resource department database.

**Accessing Existing Data**

The hospital departmental data were documented on the Financial and Human Resources (Appendix C) and Risk Management Unit Measures Data Collection Forms (Appendix D). The investigator developed the English version of the forms. Prior to data collection the
forms were pilot tested for comprehension and ease of use with unit managers and representatives from the hospital departments (finance, human resource and risk management). During the pilot testing the participants were asked to comment on each item for clarity. Items requiring clarification were refined prior to data collection.

The data that were not available through the hospital departmental databases were collected with a short survey of unit managers (Appendix B). The English version of the survey was developed by the investigator by using the principles of constructing a questionnaire as outlined by Dillman (2007). The English version of the form was pilot tested prior to data collections with five unit managers not participating in the study. The unit managers were asked to comment on the clarity of each item. Questionable items were refined prior to data collection.

For data collection in Quebec, the data collection and consent forms were translated into the French language and back translated into English. For the purpose of ensuring comprehension, all of the translated data collection forms were pilot tested with 5 Francophone unit mangers. Any discrepancies were corrected by soliciting the opinions of both English and French speaking unit managers and relevant hospital personnel not participating in the study.

**Data Collection Procedures**

The researcher met with the CNO at each hospital to introduce the study and obtained the names, work telephone numbers and email addresses for all of the unit managers of the inpatient units eligible to participate in the study. The researcher contacted and arranged a meeting with the unit managers. During the meeting the researcher explained the study, answered questions and distributed the unit manager survey (Appendix B). The unit manager inserted the completed data collection forms into an envelope that was provided by the researcher. At the preference of the unit manager, the completed surveys were either picked up from the hospital by the researcher or returned by the unit manager to the Faculty of Nursing at the University of Toronto via the Canadian Postal Service. If the survey was mailed, an addressed, stamped envelope was provided by the researcher and distributed with the survey.
The researcher also obtained from the CNO at each hospital the names, work telephone numbers and email addresses for the hospital personnel responsible for extracting the data from the hospital databases. The researcher met with the identified hospital personnel, explained the study and distributed the hospital financial and human resource (Appendix C) and risk management unit measures data collection forms (Appendix D). The hospital personnel inserted the completed data collection forms into an envelope provided by the researcher. At the preference of the hospital personnel, the completed forms were either picked up from the hospital by the researcher or returned by the hospital personnel to the Faculty of Nursing at the University of Toronto via the Canadian Postal Service. If the forms were mailed an addressed, stamped envelope was provided by the researcher and distributed with the forms.

To increase the response rate for the unit manager survey the following steps were implemented: (a) one week after the initial survey was distributed an email was sent to the unit managers thanking them for completing the survey and reminding them to send the completed unit manager survey if they had not yet done so (Appendix E); (b) a letter with a replacement survey was sent to non-respondents 2-4 weeks after the initial survey was distributed prompting the unit manager to respond (Appendix F); (c) if there wasn’t a response two weeks after the third contact a final email was sent to the unit manager requesting their response (Dillman, 2007: Appendix G). If a unit manager survey was not received within the one year period designated for data collection, the unit data were considered missing.

If the financial and human resource and risk management unit measures data collection forms were not received one week after they were distributed the researcher sent an email message to the responsible hospital personnel reminding them to send the completed data collection forms (Appendix H). If by 2-4 weeks following the initial distribution of the data collection forms the completed data forms were not received a letter (Appendix I) with replacement forms were sent to the responsible hospital personnel encouraging them to complete the forms. If there wasn’t a response two weeks after the third contact a final email was sent to the hospital personnel requesting their response (Dillman, 2007: Appendix J). If the financial
and human resource and risk management data were not obtained within the one year period designated for data collection, the data were considered missing.

**Compensation**

The participants were not paid for their time; however incentives were offered to the unit managers and the hospitals. The unit managers received a $2.00 coffee coupon with the initial unit manager survey. The hospitals were offered $10.00 cash per unit for extracting and documenting the finance, human resource and risk management data on the appropriate data collection forms. The hospital incentive was offered at the beginning of the hospital’s data collection period. The incentives were considered to be a form of acknowledgment of the unit managers’ and hospitals’ effort to provide the data.

**Plan for Data Analysis**

Structural equation modeling (SEM) was used to test the proposed relationships. SEM allowed for the testing of models that contained both concepts and observed variables (indicators) by combining path modeling and confirmatory factor analysis (Schumacker & Lomax, 2004). Concepts are the constructs or unobserved variables within the model which cannot be directly measured but are operationalized with respective indicators. Concepts can be independent, mediating, and/or dependent variables. Observed variables or indicators are used to represent the concepts. The indicators are chosen based on their ability to provide theoretical meaning to the concept. Three or four indicators per concept are recommended to achieve adequate model identification (Baer, 2006).

Structural equation modeling involves two major stages, validating the measurement model and fitting the structural model. In order to validate the measurement model exploratory followed by confirmatory factor analysis (Mulaik & Millsap, 2000) was used to verify if the indicators used to measure the respective concepts represent the constructs as expected based on the theory. Confirmatory factor analysis seeks to determine if the indicators load as predicted on the respective concept while accounting for measurement error (Schumacker & Lomax, 2004).
Once the measurement model was validated, the theoretical model was evaluated for model fit using structural equation modeling. The statistical fit of the model and substantive meaning of the model was assessed with three criteria as identified by Schumacker and Lomax (2004). They included (a) the model fit criteria, represented by a nonstatistically significant chi-square test; a small value (≤ 0.05) of the root-mean square error approximation (RMSEA); and a comparative fit index (CFI) ≥ 0.90, (b) the statistical significance of individual parameter estimates for the hypothesized paths in the model: this criterion is tested with the t value (critical value of 1.96 at the level of .05 level of significance), and (c) the magnitude and direction of the parameter (Schumacker & Lomax).

Based upon a variance-covariance matrix (Schumacker & Lomax, 2004) created with SPSS, SEM was used to test the proposed relationships among the concepts and observed or manifest (outcome) variables of the nursing intellectual capital model. The relationships are reflected in the paths linking the 4 latent and 8 manifest (outcome) variables. Although nine hypotheses were specified, they were tested simultaneously through SEM. The hypotheses are illustrated in the model presented in Figure 2.

The empirical evidence indicates that nurse staffing variables can differ by unit type (Welton, Unruh & Halloran, 2006) thus the variables included in the analysis were compared across unit type. The variables representing the nurse staffing concept and RN recruitment were found to vary by unit type. Therefore in the model testing, unit type was included as a covariate and its influence was controlled for statistically through the path between unit type and these variables. Unit type represented the following categories, and was treated as an ordinal variable: specialty units (assigned a value of 1), medical-surgical units (2), and long term complex continuing care (3) units. The ordinal value assigned to each category was based on patient length of stay with the longest patient length of stay usually found for long term-complex continuing care units and the shortest patient length of stay for specialty units. A categorical variable can be represented as a continuous variable if it contains more than 2 categories and the categories are normally distributed, as was the case for unit type. Recent evidence indicates that the influence of ordinality on the $\chi^2$ becomes less of an issue as the number of categories increases beyond two (Bryne, 2001).
Since the inpatient units were nested within hospitals and hospitals were nested within regions, multilevel structural equation modeling analysis could have been used to account for the hospitals’ and regions’ influence on the proposed relationships among the concepts. However, multi-level SEM would have required a large sample of hospitals and units that exceeds the resources available for this study (Maas & Hox, 2005).

**Data Management**

The data were extracted from the instruments, coded and entered into SPSS 17.0. Descriptive statistics was used to analyze the unit characteristics. AMOS 17.0 (a SEM program) was used to test the proposed model using the data obtained from the Financial/Human Resources Unit Measures Form, Risk Management Unit Measures Form and the Unit Manager Survey.

Prior to testing the proposed relationships among the variables, the data were reviewed for entry mistakes, missing data or outliers. Twenty completed questionnaires were randomly selected and reviewed for accuracy of data entry. Individual variables were examined for out of range values, and plausibility of means and standard deviations. Entry mistakes were corrected by reviewing data collection forms and reentering the data. Missing data were addressed by first determining if the data were available and reentering it. If the values were missing for a specific variable for ≥40% of the sample, the variable was removed from further analysis. If a participating unit had missing data values for 15% of the variables and the data were not retrievable, the unit was deleted from the data analysis (Raymond, 1986).

Outliers are data points that are extreme or atypical on any variable. This can occur as the result of data entry errors, instrument errors, biased or actual extreme values from self-report data (Schumacker & Lomax, 2004). If outliers were identified attempts were made to determine if the outlier represents a valid entry, at which point the outlier was explained (Schumacker & Lomax). If there were a large number of outliers the analyses was run with and without the outliers and the results were compared to determine if their exclusion made a difference to the model fit statistics or the results pertaining of the proposed relationships among the variables.
Ethics and Protection of Human Subjects

Informed consent giving permission for the hospital to participate in the study was obtained from the hospital’s chief executive nursing officer or delegate (Appendix K). Return of the completed unit manager survey by the unit manager was considered consent. The disclaimer letter that accompanied the unit manager survey stated that the unit manager had the right to not participate as indicated by returning a blank unit manager survey (Appendix L). The data extracted from the hospital databases were non-identifying and were routinely used for reports and administrative decision-making. The collection of these data provided minimal risk and no additional consent was required. An information letter accompanied the financial and human resource and risk management data collection forms explaining that the hospital had consented to participate in the study and the hospital personnel had permission to provide the researcher with the requested information (Appendix M).

Protection and Confidentiality of Data

The hospitals’, CNOs’ and the participants’ (i.e. unit manager) privacy was strictly maintained. All information obtained from the unit managers and the hospital finance, human resource and risk management personnel did not include the hospital’s, unit manager’s, or CNO’s names. All data collection forms were coded by the researcher. The data were entered into a database on a University of Toronto, Faculty of Nursing computer which had been assigned to the researcher for the purpose of data analysis. The computer was password protected and placed in a closed, locked office accessible only to the researcher. The data were backed up on a memory stick which was stored in a locked file cabinet at the Faculty of Nursing when not in use. The results are presented for the total sample and in a way that does not identify the participating hospitals and units.

The code sheet which identifies the hospitals, units and unit managers was kept in hard copy (hand written) only. Only the researcher had access to the code sheet that links the hospital, unit and unit manager to the data. When not in use it was stored in a locked file cabinet separate from the completed data collection forms at the Faculty of Nursing. The file cabinet was located behind locked doors and accessible only to the researcher. The code sheet was destroyed by shredding after the data were entered into computerized database. The cover
sheet that was attached to the financial, human resource and risk management forms was removed and a code number was assigned. To assure that the participants’ privacy was protected, the hospital did not receive results from their individual site data. If requested, upon the completion of the data analysis, the hospital may receive the results from the entire study sample in the form of a research brief.

All data collection forms were stored in a locked file cabinet at the Faculty of Nursing, University of Toronto when not in use. The file cabinet was placed in a closed, locked office accessible only to the researcher. The data will be kept in a lock file cabinet at the Faculty of Nursing for a period of five years and will only be accessed by the researcher. After five years the data will be destroyed by shredding.

**Summary**

In summary, this chapter presented the research design, setting and sample, description of the variables and measures, procedures for data collection, analysis and protection of data. The study tested the middle-range theory of nursing intellectual capital by using data collected from two sources (a) secondary data from hospital human resource and risk management databases, and (b) a short survey of unit managers.
Chapter 4
Results

This chapter presents the results of the analysis conducted to examine the relationships among nursing human capital, nursing structural capital, nurse staffing, employer support for nurse CPD and patient and organizational outcomes within acute care hospitals. Nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) was operationalized as academic preparation of nurses in inpatient units or proportion of RNs with degrees, proportion of RNs with specialty certification, number of hours of CE attended by RNs, professional experience of RNs and unit tenure of RNs. Nurse staffing was operationalized as hours per patient per day (HPPD), skill-mix, and RN-to-patient ratio. Employer support for nurse CPD was operationalized as time off to learn, financial assistance, replacement staff and ratio of clinical educator/consultant to RNs. Nursing structural capital was operationalized as the availability of practice guidelines for the prevention of patient falls, medication errors and hospital-acquired infections. Patient outcomes were operationalized as the rate of adverse events of patient falls, medication errors and hospital-acquired infections. Recruitment and retention outcomes were operationalized as the proportion of RN earned hours used for RN orientation, and RN vacancy, RN turnover and RN recruitment rates. The chapter is divided into five main sections addressing response rate, data management, characteristics of participating units, comparison among units, and model testing.

Participation and Response Rates

This study required the participation of several hospitals to accrue the required number of units. The hospitals’ participation involved the extraction of data from several departments and the survey of unit managers within each hospital. In addition, it was necessary to institute a data management plan in order to address issues in the data related to outliers, missingness and nonnormal distribution; which led to the elimination of some units from the analysis. The following subsections present the hospital participation rate, hospital department response rate, and unit manager response rate. It is followed by an explanation of the data management
plan and its influence on the type of units included in the analysis. Figure 3 summarizes the hospital participation rate, survey response rate and the results of the data management.

**Hospital participation rate.**

Thirteen hospitals, comprising an estimated sample size of 209 inpatient units, indicated initial interest to participate in the study and willingness to provide the data. After initially expressing interest, seven hospitals subsequently declined enrollment due to difficulty accessing data \( (n = 4) \), change in administrative leadership \( (n = 2) \), and lack of support for nursing research \( (n = 1) \). Six hospitals, 3 in Ontario and 3 in Quebec, agreed to participate in the study. This resulted in a hospital participation rate of 46.2\% and an eligible sample of 147 inpatient units.

**Hospital department response rate.**

Data were collected from two sources, hospital departmental databases (finance, human resource and risk management: Appendixes C & D), and unit managers (Appendix B). One site elected to distribute the financial, human resource and risk management data collection forms along with the unit manager survey to the unit managers \( (n = 18) \). Fifty percent \( (n = 9) \) of this group of unit managers returned the forms. The remaining fiscal, human resource and risk management data collection forms \( (n = 129) \) were distributed to pertinent hospital departments. The related hospital departments returned data for all of the requested units \( (n = 129; 100\%) \). Overall, finance, human resources and risk data were received for 138 (94\%) of the 147 eligible units. Nine unit managers (7 adult medical-surgical and, 2 specialty inpatient units) from one site did not return the hospital departmental data collection forms despite follow-up reminders.
Figure 3. Summary of Hospital Participation, Survey Response and Data Management

13 Hospitals approached to participate (209 inpatient units)

7 Hospitals declined to participate (62 inpatient units)

6 Hospitals agreed to participate (147 eligible inpatient units)

Hospital Departmental Data returned for 138 inpatient units

Unit Manager Survey returned for 105 inpatient units

Data pooled and available for 138 inpatient units (cases)

Data management plan implemented 47 inpatient units (cases) eliminated

Complete and usable data for 91 inpatient units (cases)
Unit manager response rate

The unit manager survey was distributed to 147 unit managers. A total of 105 managers returned the surveys for a response rate of 71%. Eight unit managers from 5 adult medical-surgical, 2 specialty and 1 long term-complex continuing care units returned blank surveys. Unit managers for 34 inpatient units (20 adult medical surgical, 12 specialty, 2 long term-complex continuing care) did not respond despite follow-up reminders. The majority of the eight unit managers (n = 7) who refused to participate indicated in writing (on survey or via email) that they were unable to provide the data due to time constraints.

Data Management

The data for this study were collected from multiple sources and pooled to create a comprehensive database of all indicator variables of interest. As reflected in Table 2 (under pooled sample representing the units from all participating hospitals with data on some variables of interest), nine managers (7 adult medical-surgical, 2 specialty inpatient units) from hospital site 3 had missing data for all variables and were removed from the analysis. Thus data pertaining to the indicators of the theory concepts were obtained for 138 cases creating a pooled sample of 71 adult medical-surgical, 42 specialty and 25 long term-complex continuing care inpatient units. However, the initial review of the data provided from the returned financial, human resource and risk management data collection forms and unit manager surveys indicated that there were missing data for several variables and high variability among the unit responses to individual items on the forms. The variability in the responses led to skewed distribution for some variables. Therefore, the following data management steps were taken to address missingness and skewed distribution of the responses which resulted in some units being eliminated from the analysis. Each variable was independently reviewed for missing data. Cases (i.e., units) with missing data for > 15% of the variables were excluded from the analysis as recommended by Raymond (1986). Variables were excluded from further analyses if more than 40% of the cases had missing data for the variable. One variable, clinical specialty experience, had missing data on at least 40% of the cases; thus this variable was omitted from further analysis that is, model testing. In addition, the unit managers’ responses for the RN-to-patient ratio were clear and complete
for only the day shift/weekdays category. The responses for the other categories (day shift/weekends, evening shift/weekdays, evening shift/weekends, night shift/weekdays and night shift/weekends) were unclear or missing for > 40% of the cases. The latter categories were excluded, and the RN-to-patient ratio was represented for the day shift during weekdays only.
Table 2. Unit Type per Hospital Site

<table>
<thead>
<tr>
<th>Hospital Site by Region</th>
<th>Eligible (n =147)</th>
<th>Pooled (n = 138)</th>
<th>Final (n = 91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>12</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Specialty</td>
<td>11</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>16</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>subject</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>24</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Specialty</td>
<td>7</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Specialty</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>11</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Specialty</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult medical-surgical</td>
<td>23</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Specialty</td>
<td>14</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Long term-complex</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>continuing care</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The eligible sample reflects all units that met eligibility criteria within each site; the pooled sample reflects the sample after the 9 cases were eliminated from analysis due to missing data for all variables; and the final sample reflects units with normally distributed data used in the analysis.
The distributions of data were carefully examined to determine extent of skewness. For variables demonstrating skewness (Standard Error of Skewness > -2 to +2), the reasons for skewness (such as data entry errors and outliers) were identified and addressed appropriately. Data entry errors were corrected. Outliers, defined as cases with values on the variable greater than ± 3 SD were removed (Field, 2009). With the application of the strategies for addressing missingness and skewness, 47 units (25 adult medical surgical, 18 specialty, 4 long term-complex continuing care) were eliminated. Accordingly, as Table 2 presents, 91 cases (units) were included in the analysis, representing 62% of the 147 units that agreed to take part in the study. In addition, one variable was eliminated, leaving 22 variables for the analysis. A summary of eligible units, pooled sample and final sample by hospital site and unit type is presented in Table 2.

To determine how the units sample included in the final analysis differed from the excluded units, the two samples that is, the sample of units included in the analysis (final) and the sample all units excluded because of missingness or skewness (excluded), were compared by unit. Unit type was the only variable available for comparison of the two samples of units. The results indicated that the final sample included in the analysis had a larger percentage of long-term-complex continuing care units than the group of units excluded from the study, $\chi^2 (2, N = 147) = 6.24, p < .04$, which could have resulted in overrepresentation of long term-complex continuing care units in the sample included in the analysis. Nonetheless, the sample used in the analysis is representative of all types of units embedded within university affiliated teaching hospitals located in Ontario and Quebec (Canadian Healthcare Association, 2009) that are able to provide the requested data. Table 3 presents a comparison of the study sample on unit type.
Table 3. Comparison of final and excluded units by Unit Type

<table>
<thead>
<tr>
<th>Unit Type</th>
<th>Eligible (N = 147)</th>
<th>Pooled (N = 138)</th>
<th>Excluded* (N = 56)</th>
<th>Final* (N = 91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult medical-surgical</td>
<td>78 (53)</td>
<td>71 (51)</td>
<td>32 (57)</td>
<td>46 (51)</td>
</tr>
<tr>
<td>Specialty</td>
<td>44 (25)</td>
<td>42 (30)</td>
<td>20 (36)</td>
<td>24 (26)</td>
</tr>
<tr>
<td>Long term-complex continuing care</td>
<td>25 (17)</td>
<td>25 (18)</td>
<td>4 (7)</td>
<td>21 (23)</td>
</tr>
</tbody>
</table>

Note: Eligible sample = all units that met eligibility criteria; Pooled sample = all units that returned data; Sample final = the units included in the analysis; Sample excluded = units eliminated from the analysis due to missingness or skewness of data; * denotes samples that were tested and found to differ significantly in terms of unit type.
**Characteristics of Participating Hospitals**

The hospital characteristics included type, location, and size of hospital. The 6 hospitals that took part in the study were university affiliated teaching hospitals located in two Canadian provinces. Hospital size was characterized by the number of inpatient beds. The sample was evenly distributed ($n = 2$ in each category) among small (< 500 beds), medium (501-1000 beds) and large (> than 1000 beds) sized hospitals. The type of hospitals and units participating in the study did not vary significantly by province. Therefore, the units were pooled for testing the study hypotheses.

**Characteristics of Participating Units**

Table 4 summarizes the characteristics of the participating units. The inpatient units ($n = 91$) were described in terms of clinical specialty, number of beds, average patient length of stay and mean age of RNs employed on the unit. As shown in Table 5 the clinical specialty of the units varied. The majority of the units (51.6%) were adult medical-surgical units. The number of patient beds ranged from 6 to 64, with a mean of 27 beds ($SD = 10.57$). Due to the inclusion of inpatient units where the patient’s hospitalizations are long (such as long term and complex continuing care units), the mean patient length of stay was 98 days ($SD = 245$; Range = 1.5-1080; Median = 8.70). The mean age of RNs employed on the unit was 42 years ($SD =5$; Range = 34-57 years).

**Study Variables**

The nursing intellectual capital theory proposes relationships among four concepts and quality of care and organizational outcomes. Each of the four concepts: nurse staffing, nursing human capital, employer support for nurse CPD and nursing structural capital was operationalized with observed variables (indicators). The observed variables for the four concepts and outcomes were measured with specific inpatient unit-level empirical indicators (study variables). Similarly, quality of care and organizational outcomes were represented with specific study variables. The measures of central tendency and dispersion of the study variables are presented in Table 5 (continuous variables) and Table 6 (dichotomous variables). All study variables reflect measures at the level of inpatient units.
Table 4. *Descriptive Statistics for Unit Characteristics*

<table>
<thead>
<tr>
<th>Unit Characteristic</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Type</strong></td>
<td></td>
</tr>
<tr>
<td>Adult Medical-Surgical</td>
<td>46 (51)</td>
</tr>
<tr>
<td>Specialty</td>
<td></td>
</tr>
<tr>
<td>Adult Critical-Care</td>
<td>10 (11)</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>Adult Psychiatry</td>
<td>4 (4.4)</td>
</tr>
<tr>
<td>Long Term-Complex Continuing Care</td>
<td>21 (23)</td>
</tr>
<tr>
<td>Long Term Care</td>
<td>11 (12)</td>
</tr>
<tr>
<td>Complex Continuing Care</td>
<td>10 (11)</td>
</tr>
<tr>
<td><strong>Number of Beds</strong></td>
<td></td>
</tr>
<tr>
<td>≤ 25</td>
<td>37 (41)</td>
</tr>
<tr>
<td>26-50</td>
<td>51 (56)</td>
</tr>
<tr>
<td>51-75</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (1)</td>
</tr>
<tr>
<td><strong>Patient Length of Stay in Days</strong></td>
<td></td>
</tr>
<tr>
<td>≤ 5 days</td>
<td>21 (23)</td>
</tr>
<tr>
<td>6-14 days</td>
<td>35 (39)</td>
</tr>
<tr>
<td>15-30 days</td>
<td>19 (21)</td>
</tr>
<tr>
<td>&gt;31 days</td>
<td>13 (14)</td>
</tr>
<tr>
<td>Missing</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Age of RNs</strong></td>
<td></td>
</tr>
<tr>
<td>31-40 years</td>
<td>36 (40)</td>
</tr>
<tr>
<td>41-50 years</td>
<td>48 (53)</td>
</tr>
<tr>
<td>&gt; 50 years</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Missing</td>
<td>2 (2)</td>
</tr>
</tbody>
</table>

*Note. N = 91*
Table 5. **Descriptive Statistics for Continuous Study Variables**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Study Variables</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Staffing</td>
<td>HPPD</td>
<td>83</td>
<td>7.11 (3.44)</td>
<td>.60</td>
<td>17.99</td>
<td>.954</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>Skill-mix</td>
<td>91</td>
<td>.67 (.19)</td>
<td>.11</td>
<td>1.00</td>
<td>-.477</td>
<td>-.426</td>
</tr>
<tr>
<td></td>
<td>RN-to-patient ratio</td>
<td>89</td>
<td>4.13 (1.50)</td>
<td>1.00</td>
<td>8.00</td>
<td>-.194</td>
<td>.255</td>
</tr>
<tr>
<td>Nursing Human Capital</td>
<td>Proportion of RNs with degrees</td>
<td>90</td>
<td>.34 (.21)</td>
<td>0.00</td>
<td>1.00</td>
<td>1.02</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td>Proportion of RNs with certification</td>
<td>90</td>
<td>.10 (.13)</td>
<td>0.00</td>
<td>.59</td>
<td>1.56</td>
<td>1.96</td>
</tr>
<tr>
<td></td>
<td>Hours of CE attended by RNs</td>
<td>82</td>
<td>1371 (1733)</td>
<td>16</td>
<td>7400</td>
<td>1.55</td>
<td>1.60</td>
</tr>
<tr>
<td></td>
<td>RN professional experience</td>
<td>75</td>
<td>12.05 (4.88)</td>
<td>2.34</td>
<td>26.00</td>
<td>.566</td>
<td>.284</td>
</tr>
<tr>
<td></td>
<td>RN unit tenure rate</td>
<td>55</td>
<td>5.74 (2.93)</td>
<td>.94</td>
<td>12.00</td>
<td>.518</td>
<td>-.897</td>
</tr>
<tr>
<td>Employer Support for Nurse CPD</td>
<td>Proportion of RNs received funding</td>
<td>89</td>
<td>.56 (.39)</td>
<td>0.00</td>
<td>1.00</td>
<td>-.06</td>
<td>-1.65</td>
</tr>
<tr>
<td></td>
<td>Time off to learn (hours)</td>
<td>85</td>
<td>14.96 (11.71)</td>
<td>.00</td>
<td>55.15</td>
<td>1.34</td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td>Ratio of clinical educator-to-RN</td>
<td>86</td>
<td>.02 (.02)</td>
<td>0.00</td>
<td>0.06</td>
<td>.742</td>
<td>.287</td>
</tr>
<tr>
<td></td>
<td>Percent of time RNs replaced</td>
<td>87</td>
<td>79.51 (30.04)</td>
<td>.00</td>
<td>1.00</td>
<td>-1.52</td>
<td>1.22</td>
</tr>
</tbody>
</table>

*Note.* HPPD = hours per patient per day; RN = registered nurse; CE = continuing education.
<table>
<thead>
<tr>
<th>Concept</th>
<th>Study Variables</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Patient Care Outcomes</td>
<td>Medication error rate</td>
<td>85</td>
<td>3.42 (2.72)</td>
<td>.00</td>
<td>10.94</td>
<td>.882</td>
<td>.131</td>
</tr>
<tr>
<td></td>
<td>Patient fall rate</td>
<td>87</td>
<td>3.48 (2.71)</td>
<td>.00</td>
<td>10.37</td>
<td>.69</td>
<td>-.385</td>
</tr>
<tr>
<td></td>
<td>Hospital-acquired infection rate</td>
<td>85</td>
<td>.70 (.89)</td>
<td>.00</td>
<td>3.69</td>
<td>1.58</td>
<td>1.87</td>
</tr>
<tr>
<td>RN Recruitment and Retention Outcomes</td>
<td>RN orientation hours</td>
<td>90</td>
<td>.03 (.02)</td>
<td>.00</td>
<td>.08</td>
<td>.682</td>
<td>-.097</td>
</tr>
<tr>
<td></td>
<td>RN vacancy rate</td>
<td>90</td>
<td>.10 (.10)</td>
<td>.00</td>
<td>.47</td>
<td>1.26</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>RN turnover rate</td>
<td>87</td>
<td>.10 (.09)</td>
<td>.00</td>
<td>.45</td>
<td>1.40</td>
<td>2.60</td>
</tr>
<tr>
<td></td>
<td>RN retention rate</td>
<td>91</td>
<td>.16 (.12)</td>
<td>.00</td>
<td>.58</td>
<td>.58</td>
<td>.518</td>
</tr>
</tbody>
</table>

*Note. HPPD = hours per patient per day; RN = registered nurses; CE = continuing education.*
Table 6. Descriptive Statistics for Dichotomous Study Variables

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of practice guidelines for the prevention of falls</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>19 (20.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>70 (76.9)</td>
</tr>
<tr>
<td>Missing</td>
<td>2 (2.1)</td>
</tr>
<tr>
<td>Availability of practice guidelines for the prevention of medication errors</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>8 (8.8)</td>
</tr>
<tr>
<td>Yes</td>
<td>78 (85.7)</td>
</tr>
<tr>
<td>Missing</td>
<td>5 (5.5)</td>
</tr>
<tr>
<td>Availability of practice guidelines for the prevention of hospital-acquired infections</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>Yes</td>
<td>87 (95.6)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (1.1)</td>
</tr>
</tbody>
</table>

*Note: N = 91*
As summarized in Table 5, the nurse staffing concept was manifested by 3 study variables: HPPD, skill-mix and RN-to-patient ratio. The participating units had a mean of 7 hours per patient per day of nursing care. On average, the unit skill-mix consisted of 67% RN, and a RN-to-patient ratio of 1-to-4.

Empirically, the nursing human capital concept was measured with the proportion of RNs with degrees, proportion of RNs with certification, hours of CE attended by RNs, mean number of years of RN professional experience and the mean number of years of RN unit tenure. On average one third of the RNs on the participating units held university degrees; however, only 10% were specialty certified. The RNs had a mean of 12 years of professional experience and had been employed by the unit for nearly 6 years. The unit managers reported that RNs on their respective unit participated in a varying number of hours of CE in the previous fiscal year, ranging from 16 to 7400 hours, with a mean of 1371.

Four study variables were used to operationalize the employer support for the nurse CPD concept: proportion of RNs received funding, time off to learn, ratio of clinical educator-to-RN and percent of time RNs replaced. On average employers provided financial support for 56% of the RNs to attend CPD. They also supported RNs’ ongoing learning by providing approximately 15 hours paid time off to attend CPD, replacement staff 80% of the time when the RNs were away from the unit to learn. The employers also provided clinical educators for clinical decision-making at a ratio of .02 clinical educator-to-1 RN.

The study variables used to reflect the quality of patient care outcomes included the adverse events of medication errors, patient falls and hospital-acquired infections. Annualized and assessed at the inpatient unit-level, there were on average, 3 medication errors and 3 patient falls per 1000 patient days. Hospital-acquired infection rate was < 1 per 1000 patient days ($M = .70; SD = .89$).

The organizational outcomes of interest were related to RN recruitment and retention. The study variables representing these outcomes included the proportion of inpatient RN earned hours used to orient RNs, RN unit vacancy rate, RN turnover rate and RN recruitment rate. The units reported a mean of 3% of their inpatient RN earned hours were used for RN
orientation. On average, the RN unit turnover rate was 10%, while the RN recruitment rate was 16% and RN vacancy rate was 10% for the previous fiscal year.

The nursing structural capital concept was measured as the availability of practice guidelines for the prevention of adverse events (Table 6). Practice guidelines were available for the prevention of adverse events on most of the participating units: medication errors (87%), patient falls (70%), and hospital-acquired infections (87%).

**Comparison among Units**

Different types of units participated in the study. Previous research showed that some of the study variables vary across types of units (Welton, Unruh & Halloran, 2006); therefore, comparison among types of units that were included in the analysis was done on all indicators of the theory’s concepts and outcomes. The units were categorized into: adult medical-surgical units, specialty units (pediatric, adult critical care, psychiatric and obstetrical units) and long term-complex continuing care units. The measures of central tendency and dispersion for the study variables for the 3 types of units are presented in Table 7.

The indicators of the nurse staffing concept differed significantly among the 3 types of units (Appendix N). Higher levels of nurse staffing were reported for the specialty units: HPPD, $F(2, 88) = 20.27, p < .01$; skill-mix, $F(2, 88) = 36.19, p < .01$; and RN-to-patient ratio, $F(2, 88) = 10.97, p < .01$, than for long term-complex continuing care and medical-surgical units.

The 3 types of units differed significantly on two of the nursing human capital concept indicators: proportion of RNs with degrees, $F(2, 88) = 9.67, p < .01$, and hours of CE attended by RNs, $F(2, 88) = 18.98, p < .01$ (Appendix N). As compared to adult medical-surgical and long term-complex continuing care units, the specialty units reported a higher proportion of RNs with degrees and specialty certification. As well, RNs working on adult medical-surgical units participated in a higher number of hours of CE more so than did nurses on long term-complex continuing and specialty units. All types of units had moderate levels of RN professional experience and RN unit tenure.
There were significant between-unit differences for most indicators of the employer support for nurse CPD concept. Specifically, the ratio of clinical educator-to-RN, $F(2, 88) = 7.53, p < .01$, percent of time RNs were replaced when away from the unit to learn, $F(2, 88) = 3.56, p < .001$, and proportion of RNs receiving financial assistance from employer to attend CPD activities $F(2, 88) = 4.41, p < .001$, differed across unit types. Although statistically significant (due to small but equal standard deviations across units), the ratio of clinical educator-to-RN was slightly higher on long term-complex continuing units than other types of units. The percent of time RNs were replaced was higher in medical-surgical and specialty units than long term or complex continuing care units. A higher proportion of RNs working in specialty units received financial assistance from their employers to attend CPD activities than nurses working in adult medical-surgical units, or long term-complex continuing care units. Time off to learn was comparable across unit type.

Two of the quality of care indicators differed significantly for the 3 types of units: medication errors, $F(2, 88) = 4.41, p < .01$, and patient falls, $F(2, 88) = 10.83, p < .01$. Medical-surgical units reported higher rates for medication errors and hospital-acquired infections whereas the long term-complex continuing care units reported highest rates for patient falls.

Similarly, although not statistically significant, small differences in recruitment and retention outcomes were observed for the 3 types of units. Specialty units reported a smaller proportion of inpatient earned hours used for RN orientation than other types of units. The RN vacancy rate was higher for medical-surgical units than the other units. Long term care units reported fewer turnovers than the specialty and adult medical-surgical units. However there were statistically significant differences between unit types for RN recruitment rates, $F(2, 88) = 5.62, p < .01$; with medical-surgical units reporting higher RN recruitment rates than the other types of units.
### Table 7. Study Variables by Unit Type

<table>
<thead>
<tr>
<th>Concept</th>
<th>Study Variables</th>
<th>Adult medical-surgical n= 46 M(SD)</th>
<th>Specialty n = 24 M(SD)</th>
<th>Long term and Complex Continuing Care n=21 M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Staffing</td>
<td>HPPD</td>
<td>7.67 (1.68)</td>
<td>9.23 (5.38)</td>
<td>4.19 (2.41)</td>
</tr>
<tr>
<td></td>
<td>Skill-mix</td>
<td>.71 (.13)</td>
<td>.79 (.15)</td>
<td>.45 (.16)</td>
</tr>
<tr>
<td></td>
<td>RN-to-patient ratio</td>
<td>4.26 (.95)</td>
<td>3 (1.7)</td>
<td>5.26 (1.4)</td>
</tr>
<tr>
<td>Nursing Human Capital</td>
<td>Proportion of RNs with degrees</td>
<td>.33 (18)</td>
<td>.47 (25)</td>
<td>.21 (14)</td>
</tr>
<tr>
<td></td>
<td>Proportion of RNs with certification</td>
<td>.07 (10)</td>
<td>.15 (14)</td>
<td>.09 (16)</td>
</tr>
<tr>
<td></td>
<td>Hours of CE attended by RNs</td>
<td>1823 (1936)</td>
<td>1610 (1753)</td>
<td>271 (186)</td>
</tr>
<tr>
<td></td>
<td>RN professional experience</td>
<td>11.74 (4.73)</td>
<td>13.20 (4.5)</td>
<td>11.23 (5.26)</td>
</tr>
<tr>
<td></td>
<td>RN unit tenure</td>
<td>5.76 (2.73)</td>
<td>5.47 (3.54)</td>
<td>6.00 (2.70)</td>
</tr>
<tr>
<td>Concept</td>
<td>Study Variables</td>
<td>Adult medical-surgical n= 46 M(SD)</td>
<td>Specialty n = 24 M(SD)</td>
<td>Long term and Complex Continuing Care n=21 M(SD)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Employer Support for Nurse CPD</td>
<td>Proportion of RNs received funding</td>
<td>.56 (35)</td>
<td>.70 (37)</td>
<td>.37 (44)</td>
</tr>
<tr>
<td></td>
<td>Time off to learn</td>
<td>14.81 (11.19)</td>
<td>14.33 (12)</td>
<td>15.91 (12.91)</td>
</tr>
<tr>
<td></td>
<td>Ratio of clinical educator-to-RN</td>
<td>.02 (.01)</td>
<td>.02 (.01)</td>
<td>.03 (.01)</td>
</tr>
<tr>
<td></td>
<td>Percent of time RNs replaced</td>
<td>85 (25)</td>
<td>85 (29)</td>
<td>63 (36)</td>
</tr>
<tr>
<td>Quality of patient care outcomes</td>
<td>Medication error rate</td>
<td>4.09 (2.73)</td>
<td>3.93 (2.91)</td>
<td>1.43 (1.24)</td>
</tr>
<tr>
<td></td>
<td>Patient fall rate</td>
<td>3.69 (2.56)</td>
<td>1.78 (2.00)</td>
<td>5.33 (2.70)</td>
</tr>
<tr>
<td></td>
<td>Hospital-acquired infections rate</td>
<td>.91 (.91)</td>
<td>.72 (1.09)</td>
<td>.24 (.33)</td>
</tr>
<tr>
<td>RN recruitment and retention outcomes</td>
<td>RN orientation hours</td>
<td>.03 (.02)</td>
<td>.01 (.02)</td>
<td>.03 (.02)</td>
</tr>
<tr>
<td></td>
<td>RN Vacancy rate</td>
<td>.11 (.11)</td>
<td>.09 (.11)</td>
<td>.09 (.11)</td>
</tr>
<tr>
<td></td>
<td>RN Turnover rate</td>
<td>.11 (.08)</td>
<td>.09 (.05)</td>
<td>.8 (.12)</td>
</tr>
<tr>
<td></td>
<td>RN Recruitment rate</td>
<td>.20 (.13)</td>
<td>.15 (.10)</td>
<td>.9 (.10)</td>
</tr>
</tbody>
</table>
The frequency distribution for the indicators of the structural capital concept by unit type is presented in Table 8. Overall, guidelines for the prevention of medication errors and hospital-acquired infections were consistently available for all unit types.

A chi-square test was conducted to evaluate whether availability of practice guidelines for the prevention of adverse events differed across types of units. Availability of practice guidelines for the prevention of patient falls varied across unit type, $\chi^2 (4, N = 90) = 21.98, p < .01$. The proportions of adult medical-surgical, long term-complex continuing care and specialty units that had practice guidelines for the prevention of patient falls were 91, 86, 43% respectively. The availability of practice guidelines for the prevention of medication errors, $\chi^2 (2, N = 86) = 1.05, p = ns$, or for the prevention of hospital-acquired infections did not differ, $\chi^2 (2, N = 90) = 2.74, p = ns$ across unit types.

In summary, the study variables (indicators of the constructs of interest) varied across adult medical-surgical, long term-complex continuing care, and specialty units. These differences were controlled for statistically in the model testing by adding unit type as a covariate.
### Table 8. *Structural Capital Variables by Unit Type*

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Adult medical-surgical n= 46</th>
<th>Specialty Units n = 24</th>
<th>Long term and Complex Continuing Care n=21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidelines for the prevention of medication errors</td>
<td>No</td>
<td>3 (7%)</td>
<td>2 (8.7%)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>40 (93%)</td>
<td>21 (91.3%)</td>
</tr>
<tr>
<td>Guidelines for the prevention of patient falls</td>
<td>No</td>
<td>4 (8.7%)</td>
<td>12 (52.2%)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>42 (91.3%)</td>
<td>10 (43.5%)</td>
</tr>
<tr>
<td>Guidelines for the prevention of hospital-acquired infections</td>
<td>No</td>
<td>1 (2.2%)</td>
<td>2 (8.3%)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>45 (97.8%)</td>
<td>22 (91.7%)</td>
</tr>
</tbody>
</table>

*Note. N = 91. Specialty unit = adult critical care, psychiatry and pediatric*
Model Testing

This section presents the results pertaining to the steps taken to test the selected propositions of the middle-range theory of nursing intellectual capital. It is divided into 4 subsections: data preparation for model testing, examination of the bi-variate relationships between variables included in the nursing intellectual capital theory, test of the measurement model; and test of the structural model. The steps are consistent with Mulaik and Millsap (2000) approach for model testing.

Data preparation for model testing.

To handle missing data on variables with < 15% missingness (that remained after data management), median substitution was used as suggested by McKnight, McKnight, Sidani and Figueredo (2007). Median substitution is appropriate in the presence of skewness which was the case for a few study variables to be included in model testing. The imputed data set was used in model testing. Multivariate normal distribution is an assumption of structural equation modeling (SEM) and is required to proceed with the analysis (Schumacker & Lomax, 2004). The imputed data set was subjected to further testing for normality and kurtosis using AMOS. Across variables, the standard error of skewness ranged from -.469 to 1.7, which was considered to fall within the acceptable range (-2 to +2). Thus, the study variables showed normal distribution. The kurtosis was also reviewed and was found to range between -1.28 and 2.29, which is within the acceptable range (-3 to +3). Therefore, none of the study variables had high kurtosis. Further, none of the study variables had outliers with values exceeding ± 3 SD. The imputed data set reflecting the final sample (n = 91) scores on the study variables (i.e. indicators of the concepts) was deemed acceptable, meeting the distributional assumptions required for model testing (Baer, 2006).

Relationships amongst variables included in the theory’s propositions.

The imputed data set (with median substitution) was used to examine the relationships among the study variables, using the Pearson correlation coefficient. The correlation matrices are presented per theory proposition and are located in Appendix O.
**Nurse staffing and human capital variables.**
The relationships between empirical indicators of the nurse staffing concept and nursing human capital concept were moderate in magnitude and varied in direction. Statistically significant positive associations were found between HPPD and proportion of RNs with degrees; skill-mix and proportion of RNs with degrees, and skill-mix and hours of CE attended by RNs. However statistically significant negative relationships were noted between RN-to-patient ratio and proportion of RNs with degrees, and RN-to-patient ratio and proportion of RNs with certification. The observed pattern of relationships indicates that inpatient units with higher hours of nursing care per patient per day and skill-mix had a higher proportion of RNs with degrees, as compared to units that had lower HPPD and skill-mix. Units with higher skill-mix also had RNs who participated in CE to a larger extent (i.e. higher number of hours), as compared to nurses on units that had lower skill-mix.

**Employer support for nurse CPD and nursing human capital variables.**
The majority of the correlations amongst the variables representing the employer support for nurse CPD and nursing human capital concepts were in the hypothesized direction, but weak in magnitude and statistically nonsignificant. The exception was a statistically significant negative association between the ratio of clinical educator-to-RN and percentage of RNs with degrees. This implies that inpatient units that employ less RNs with degrees have a high ratio of clinical educator-to-RN. In addition and as hypothesized, a statistically significant positive relationship was found between the proportion of RNs who received funding and hours of CE attended by RNs. When units provide funding to RNs to participate in CPD, the RNs on the unit engage in a high number of hours of CE.

**Nursing human capital and patient outcome variables.**
In general, the associations between the indicators of the nursing human capital concept and quality of patient care outcomes were not in the hypothesized direction (negative). Furthermore, they were weak in magnitude and statistically nonsignificant. In contrast, statistically significant moderate associations were found between proportion of RNs with degrees and rates of patient falls, proportion of RNs with degrees and hospital-acquired infections rate; and proportion of RNs with certification and hospital-acquired infections rate.
These relationships indicate that units with high proportion of RNs with degrees, and/or RNs with specialty certification have low patient fall rates and low hospital-acquired infections rates.

**Nursing structural capital and patient outcome variables.**
Variables indicating the nursing structural capital concept were not significantly associated with any of the quality of patient outcome variables as hypothesized. The relationships were weak in magnitude. Availability of practice guidelines for the prevention of adverse events (patient falls, medication errors and hospital-acquired infections) was not found to be empirically related to the rates of adverse events (patient falls, medication errors and hospital-acquired infections) of a unit.

**Nursing human capital and RN recruitment and retention outcomes.**
The relationships between indicators of the nursing human capital concept and RN recruitment and retention outcomes were in the hypothesized direction and weak to moderate in magnitude. Statistically significant associations were found between proportion of RNs with specialty certification and RN recruitment rate; RN professional experience and use of RN orientation hours; RN unit tenure rate and use of RN orientation hours; and, RN vacancy rate and RN recruitment rate. These associations, as hypothesized, indicate that nurses’ knowledge and skills (proportion of RNs with certification) and experience (RN professional experience and RN unit tenure) are related to better RN recruitment and retention outcomes of the unit.

The four step procedure recommended by Mulaik and Millsap (2000) was used to determine the fit between the nursing intellectual capital propositions and empirical data. The results of each step are presented in the next four subsections.

**Exploring the Factorial Structure of the Concepts**
The first step of the procedure involved exploration of the factorial structure of the concepts. This was performed by conducting exploratory factor analysis which aimed at determining if the proposed empirical indicators represented the respective concepts (nurse staffing, employer support for nurse CPD, nursing human capital and nursing structural capital). The
principal axis factoring method was used to extract the factors. The results were examined for potential factorability if the Kaiser-Meyer-Olkin measure of sampling adequacy was above .6 (Norman & Streiner, 2008). A factor was accepted if it had an eigenvalue of > 1 and accounted for ≥ 10% of the variance in the indicators’ values (Norman & Streiner). The loading of the indicators on the respective factor were evaluated for their magnitude. Indicators with loadings > .30 were accepted as valid measures of the concept, as recommended by Norman and Streiner.

**Nurse staffing concept.**

Exploratory factor analysis for the nurse staffing concept included the empirical indicators of HPPD, skill-mix and RN-to-patient ratio. The Kaiser-Meyer-Olkin measure of sampling adequacy was .64, above the recommended 0.6. As hypothesized the three empirical indicators of the nurse staffing concept loaded on one factor: HPPD (.51), skill-mix (.68) and RN-to-patient ratio (-.72). The factor had an eigenvalue of 1.27 and accounted for 42% of the variance in the empirical indicators. Based on the results of the factor analysis the nurse staffing concept, operationalized with its three indicators, was brought forward for model testing.

**Employer support for nurse CPD concept.**

Exploratory factor analysis for the employer support for nurse CPD concept included the empirical indicators of proportion of RNs received financial support, time off to learn, ratio of clinical educator-to-RN and percent of time replaced. The Kaiser-Meyer-Olkin measure of sampling adequacy was .50 below the recommended 0.6. The four empirical indicators of the employer support for nurse CPD concept did not load on one factor as hypothesized; therefore the concept employer support for nurse CPD was represented with its respective indicators in the model testing.

**Nursing human capital concept.**

Exploratory factor analysis for the nursing human capital concept included proportion of RNs with degrees, proportion of RNs with certification, hours of CE attended by RNs, RN professional experience and RN unit tenure. The Kaiser-Meyer-Olkin measure of sampling
adequacy was .54 below the recommended 0.6. The five empirical indicators did not load on to one factor as hypothesized. The results indicated a two-factor model. Three indicators, proportion of RNs with certification (.32), RN professional experience (.58) and RN unit tenure (.58) loaded on one factor. This factor had an eigenvalue of 1.53 and accounted for 17.03% of the variance in the empirical indicators. Two empirical indicators loaded on to the second factor; total hours of CE attend by RNs (.71) and proportion of RNs with degrees (.19). The second factor had an eigenvalue of 1.14 and accounted for 11.25% of the variance. The two factors are theoretically meaningful. While the first factor reflects skills and experience (proportion of RNs with certification, RN professional experience and RN unit tenure), the second factor represents knowledge of registered nurses on inpatient units (proportion of RNs with degrees and total hours of CE attended by RNs). However, it is not recommended to use a two indicator concept in structural equation model (Flora & Curran, 2004). Therefore the factor of knowledge was represented by its respective indicators, and the factor of skills and experience was represented by a concept (latent variable) in the next steps of model testing.

**Nursing structural capital concept.**

Exploratory factor analysis for the nursing structural capital concept included the empirical indicators of availability of guidelines for the prevention of medication errors, availability of guidelines for the prevention of falls, and availability of guidelines for the prevention of hospital-acquired infection. The Kaiser-Meyer-Olkin measure of sampling adequacy was .59. As hypothesized, the three variables loaded on one factor: guidelines for prevention of medication errors (.76), guidelines for the prevention of falls (.41), and guidelines for the prevention of hospital-acquired infections (.49). The factor had an eigenvalue of 1.60 and accounted for 33% of the variance in the empirical indicators. However all of the criteria required for accepting one factor were not met, in particular the Kaiser-Meyer-Olkin measure of sample adequacy. Therefore the nursing structural capital concept was represented by its respective indicators in the model testing.
Testing the Measurement Model

Based on the findings from the exploratory factor analyses, two concepts nurse staffing and nursing human capital-skills and experience (represented with the indicators of proportion of RNs with certification, RN professional experience, and RN unit tenure) were included in the second step of model testing. Step 2, the confirmatory factor analysis, consisted of testing the measurement model, where the relationships of empirical indicators with their respective concepts were examined simultaneously (Mulaik & Millsap, 2000). In testing the measurement model, it is recommended to constraint the loading of one indicator on its respective factor to 1.0 in order to set the measurement scale for the factor and to allow the factors to co-vary. The empirical indicators for the nurse staffing concept significantly loaded on the respective concept: skill-mix ($\beta = .685$, $SEB = .02$, $CR = 3.74$, $p < .001$) and RN-to-patient ratio ($\beta = -.723$, $SEB = .188$, $CR = -3.38$, $p < .001$); HPPD loading was constrained to 1.0. RN professional experience loaded on the concept of nursing human capital-skills and experience ($\beta = .502$, $SEB = 25.02$, $CR = 1.96$, $p < .05$); RN unit tenure did not load significantly on this concept ($\beta = .660$, $SEB = 20.87$, $CR = 1.63$, $p = .103$). The fit indices for the measurement model indicated poor fit ($\chi^2 (9) = 16.12; p = .064; CFI = .882; RMSEA = .094, PClose = .153$) as the $CFI$ is below .90, $RMSEA$ is above .05 and the $PClose$ is below .500 (Schumacker & Lomax, 2004). Therefore the nurse staffing concept was brought forward for model testing, but the empirical indicators for nursing human capital concept-skills and experience represented by proportion of RNs with specialty certification, RN unit tenure and RN professional experience were retained as separate observed variables. The indicators for the employer support for nurse CPD and nursing structural capital concepts were also retained as separate variables and brought forward, as such, for model testing.

Testing the Structural Model, Operationalizing the Nursing Intellectual Capital Theory Propositions

Step 3 involved testing the relationships among the concepts or their respective indicators as proposed in the nursing intellectual capital theory. The results of the measurement model testing suggested that the nurse staffing should be retained as a concept. In order to maintain consistency with the propositions of the theory, the other concepts were represented by their respective observed variables (empirical indicators). Therefore, the first structural model that
was tested represented the hypothesized relationships among one concept (nurse staffing) and the individual empirical indicators of the remaining concepts (employer support for nurse CPD, nursing human capital, nursing structural capital: Figure 4). The results of this model testing, although over-identified, revealed statistically nonsignificant associations, reflected in small values of the beta coefficients for the following variables: hours of CE attended by RNs, proportion of RNs received funding, time off to learn, ratio of clinical educator-to-RN and percent of time RNs replaced, RN turnover rate and the availability of guidelines for the prevention of patient falls, medication errors and hospital-acquired infection. Therefore, the paths related to these variables were omitted from the model as recommended by Schumacker & Lomax (2004). This process led to 9 variables being eliminated from further model testing. The remaining 13 variables were included in the structural model.

The potential confounding influence of unit type was controlled for; by adding paths from units type categorized as specialty units (1), adult medical-surgical units (2); long term-complex continuing care units (3), to the concept of nurse staffing and RN recruitment rate. The relationships among the 13 variables that were tested were reflective and consistent with the propositions of the theory, as depicted in Figure 5. However, the fit indices (Table 9) indicated the model had poor fit to the data as the chi-square statistic ($\chi^2$) was significant, the comparative fit index ($CFI$) was below .90, the root mean square error of approximation ($RMSEA$) was above .05, and the $PClose$ was less than .500 (Schumacker & Lomax, 2004). As recommended by Mulaik and Millsap (2000) a modified model was examined.
Figure 4. Structural Model 1-Reflecting the Nursing Intellectual Capital Theory
Figure 5. Structural Model 2- Reflecting the Nursing Intellectual Capital Theory

* < .05; ** < .01; *** < .001
Table 9. Goodness of Fit Indices for the Structural Model 2

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>P</th>
<th>CMIN/DF</th>
<th>CFI</th>
<th>RMSEA</th>
<th>PCLOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Model</td>
<td>120.5</td>
<td>68</td>
<td>.00</td>
<td>1.77</td>
<td>.769</td>
<td>.093</td>
<td>.009</td>
</tr>
</tbody>
</table>
Testing the Modified Structural Model

Since the second structural model (Figure 5) had poor fit, Step 4 involved testing a modified structural model. The modification entailed eliminating nonsignificant paths and adding paths based on the modification indices produced by AMOS. The modification indices were carefully reviewed and paths were added only if they were theoretically meaningful and congruent with the proposed theory. As depicted in Figure 6, the nonsignificant path from proportion of RNs with degrees to medication error rate was removed. The additional paths included the direct path from nurse staffing to medication error rate, nurse staffing to patient fall rate, nurse staffing to hospital-acquired infection rate, RN professional experience to RN unit tenure, and RN unit tenure to proportion of RNs with certification. Once the path was added from nurse staffing to patient fall rate, the path from proportion of RNs with degrees to patient fall rate became nonsignificant and thus was removed from the model. The modification in the path coefficient between nurse staffing and adverse events suggests that the proportion of RNs with degrees does not strongly mediate the relations between nurse staffing and adverse events.

The modification indices suggested adding associations between RN professional experience, RN unit tenure, and RN unit tenure and proportion of RN with certification, and retaining the covariance between the error terms for patient fall rate (e4) and hospital-acquired infection rate (e5). The nonsignificant covariance between unit type and professional experience and the error terms associated with skill mix (e2) and RN-to-patient ratio (e3), and RN vacancy rate (e8) and RN recruitment rate (e9) were removed. Removing and adding these paths improved the model fit.

As presented in Table 10, the fit indices for the modified structural model in Figure 6 indicate a good fit ($\chi^2 (73) = 80.57; p = .254; CFI = .967; RMSEA = .034; PClose = .718$). The chi-square statistic ($\chi^2$) was nonsignificant, the comparative fit index ($CFI$) was above .90, the root mean square error of approximation ($RMSEA$) was below .05, and the $PClose$ was >.500 (Schumacker & Lomax, 2004).
Figure 6. Modified Structural Model Reflecting the Nursing Intellectual Capital Theory

* < .05; ** < .01; *** < .001
Table 10. Goodness of Fit Indices for Nursing Intellectual Capital Modified Structural Model

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>P</th>
<th>CMIN/DF</th>
<th>CFI</th>
<th>RMSEA</th>
<th>PCLOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Structural Model</td>
<td>80.57</td>
<td>73</td>
<td>.254</td>
<td>1.10</td>
<td>.967</td>
<td>.034</td>
<td>.718</td>
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</tbody>
</table>
Table 11 presents the regression coefficients for each path of the final nursing intellectual capital modified structural model. In this model only nurse staffing was represented as a concept, measured with its 3 empirical indicators. As required in model testing (Schumacker & Lomax, 2004), the loading of one indicator (skill-mix) on the nurse staffing concept was fixed at 1.0 in order to set the measurement scale for the concept and avoid indeterminacy between the variance of the concept and the loadings of the indicators on the concept (Schumacker & Lomax, 2004, p. 65). HPPD ($B = 15.21, SE = 2.79, CR = 5.45, p < .001$) loaded positively and RN-to-patient ratio ($B = -6.64, SE = 1.26, CR = -5.29, p < .001$) loaded negatively onto the nurse staffing concept. This pattern of loading indicated that on units with high nurse staffing (high HPPD), the RNs care for fewer patients (low RN-to-patient ratio). Based on the ANOVA results (Appendix N) which showed between-unit type differences in nurse staffing, unit type was controlled for by positing a direct path from unit type to the nurse staffing concept. The direction of the beta coefficient indicates that unit type was associated with the nurse staffing on a unit ($B = -.156, SE = .022, CR = -7.29, p < .001$); specifically specialized units had higher nurse staffing (higher HPPD, lower RN-to-patient ratio) than other types of units (adult medical-surgical and long term-complex continuing care). The nurse staffing concept was directly related to the patient fall rate ($B = -8.38, SE = 2.27, CR = -3.69, p < .01$); hospital acquired infection rate ($B= 4.06, SE = .853, CR = 4.79, p < .001$) and medication error rate ($B = 7.32, SE = 2.21, CR = 3.30, p <.001$). These direct relationships suggest that when there are high levels of nurse staffing on a unit there also are low rates of patient falls, high hospital-acquired infection rates, and high medication error rates.

Nurse staffing also predicted the proportion of RNs with degrees ($B = .781, SE = .182, CR = 4.29, p < .001$); meaning that on units with high levels of nurse staffing there was a high proportion of RNs with degrees. In turn, the proportion of RNs with degrees significantly related to the rate of hospital-acquired infections ($B = -2.20, SE = .426, CR = -5.16, p < .001$) on a unit. This implies an indirect relationship between nurse staffing and the hospital-acquired infection rate which was partially mediated by the proportion of RNs with degrees on a unit. On units with high levels of nurse staffing, there also was a high
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Predictor Variable</th>
<th>$\beta$</th>
<th>$B$</th>
<th>$SE$</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse staffing</td>
<td>Unit type</td>
<td>-.815</td>
<td>-.156***</td>
<td>.022</td>
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<tr>
<td>Skill-mix</td>
<td>Nurse staffing</td>
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<td>RN-to-patient ratio</td>
<td>Nurse staffing</td>
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<td>-6.64***</td>
<td>1.26</td>
<td>-5.29</td>
</tr>
<tr>
<td>HPPD</td>
<td>Nurse staffing</td>
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<td>15.21***</td>
<td>2.79</td>
<td>5.45</td>
</tr>
<tr>
<td>Patient fall rate</td>
<td>Nurse staffing</td>
<td>-.427</td>
<td>-8.38***</td>
<td>2.27</td>
<td>-3.69</td>
</tr>
<tr>
<td>Hospital-acquired infection rate</td>
<td>Nurse staffing</td>
<td>.613</td>
<td>4.06***</td>
<td>.853</td>
<td>4.79</td>
</tr>
<tr>
<td>Medication error rate</td>
<td>Nurse staffing</td>
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<td>7.32***</td>
<td>2.21</td>
<td>3.30</td>
</tr>
<tr>
<td>Proportion of RNs with degrees</td>
<td>Nurse staffing</td>
<td>.49</td>
<td>.781***</td>
<td>.182</td>
<td>4.29</td>
</tr>
<tr>
<td>Hospital-acquired infection rate</td>
<td>Proportion of RNs with degrees</td>
<td>-.521</td>
<td>-2.20***</td>
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<td>-5.16</td>
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<tr>
<td>RN unit tenure</td>
<td>RN professional experience</td>
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<td>.175***</td>
<td>.053</td>
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</tr>
<tr>
<td>Proportion of RNs with certification</td>
<td>RN unit tenure</td>
<td>.230</td>
<td>.013*</td>
<td>.006</td>
<td>2.24</td>
</tr>
<tr>
<td>Hospital-acquired infection rate</td>
<td>Proportion of RNs with certification</td>
<td>-.326</td>
<td>-2.24***</td>
<td>.562</td>
<td>-3.99</td>
</tr>
<tr>
<td>RN recruitment rate</td>
<td>Proportion of RNs with certification</td>
<td>-.269</td>
<td>-.251**</td>
<td>.090</td>
<td>-2.79</td>
</tr>
<tr>
<td>RN vacancy rate</td>
<td>RN unit tenure</td>
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<td>-.009*</td>
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<td>.005</td>
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<tr>
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<td>RN professional experience</td>
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<td>-.001***</td>
<td>.000</td>
<td>-3.67</td>
</tr>
<tr>
<td>RN recruitment rate</td>
<td>Unit type</td>
<td>-.184</td>
<td>-.032*</td>
<td>.016</td>
<td>-1.96</td>
</tr>
</tbody>
</table>

*Note. $N = 91$; HPPD = hours per patient per day; RN = registered nurses; * $p < .05$; ** $p < .01$; *** $p < .001$*
proportion of RNs with degrees, which in turn, was associated with reduced rates of hospital-acquired infections.

Of the indicators for the human capital concept, the proportion of RNs with certification was related with the rate of hospital-acquired infection of a unit \((B = -2.24, \ SE = .562, \ CR = -3.99, \ p < .001)\). Units with a high proportion of RNs with certification also was associated with RN recruitment rates \((B = -.251, \ SE = .090, \ CR = -2.79, \ p < .01)\). These findings indicate that units with a high proportion of RNs with certification have low hospital-acquired infection rates and low RN recruitment rates (fewer newly hired RNs).

As suggested by the beta coefficients, RN professional experience was associated with the number of RN orientation hours used by the unit \((B = -.001, \ SEB = .000, \ CR = -3.67, \ p < .001)\). Specifically, units with high RN professional experience use a small proportion of their inpatient earned hours to orient RNs. RN unit tenure also contributed to the RN recruitment rate and RN vacancy rate of a unit. Units with high RN unit tenure had low recruitment \((B = -.014, \ SE = .005, \ CR = -2.74, \ p < .01)\) and vacancy rates \((B = -.009, \ SEB = .004, \ CR = -2.05, \ p < .05)\). In addition units with high RN unit tenure also had a high proportion of RNs with certification \((B = .013, \ SE = .006, \ CR = 2.24, \ p < .05)\). The type of unit also was associated with the recruitment of RNs \((B = -.032, \ SE = .016, \ CR = -1.96, \ p < .05)\) with long term or complex continuing care units recruiting significantly less RNs.

Additionally a significant covariance as found between the error terms for patient fall (e4) and hospital-acquired infection rates (e5), \(cov = .485, \ SE = .189, \ CR = 2.56, \ p < .01\). The covariance suggests that some of unaccounted variance between the error terms is shared (Schumacker & Lomax, 2004). Since patient fall rate and hospital-acquired infection rate variables are theoretically linked, as they measure similar constructs (adverse events), the respective correlated error variances could be the result of a direct relationship between the variables or measurement error (Schumacker & Lomax). The correlated error terms may also reflect common method variance which could have occurred as the type of data (risk management data) collected to measure the concepts (i.e. patient falls and hospital-acquired infections) were similar (Maruyama, 1998).
**Power Analysis**

The final modified structural model contains 13 variables that represent the concepts as originally proposed by the nursing intellectual capital theory. Between unit differences were controlled by adding unit type as a covariable in the model, yielding a total of 14 variables in the final model. The sample size of 91 cases provided 6.5 cases per variable which meets the guidelines of 5-10 cases per variable for establishing adequate power when using SEM analysis to test relationships among latent and observed variables (Schumacker & Lomax, 2004).

**Sensitivity Analysis**

To confirm the final modified structural model and to address issues related to the use of median substitution for handling missing data, the final modified structural model was retested with the original data set. Maximum likelihood (ML) estimation in AMOS (instead of median substitution) was used to replace the missing data. The sensitivity analysis replicated the results by producing similar beta coefficients, that is, the coefficients were comparable in direction, magnitude and significance, for the paths and fit indices for the model ($\chi^2(70) = 86.83; p = .129; CFI = .929; RMSEA = .046; PClose = .551$). Thus the decision to use median substitution had a minor impact on the conclusions reached in this study.
Chapter 5
Discussion

The purpose of this study was to test selected propositions of the middle-range theory of nursing intellectual capital (Covell, 2008) which delineates the relationships among factors within the work environment (employer support for nurse CPD, nurse staffing, nursing structural capital), nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD), and the quality of patient care and recruitment and retention of nurses.

This cross-sectional study of 91 inpatient units found that nurses’ knowledge, skills and experience (proportion of RNs with degrees, specialty certification, RN unit tenure and RN professional experience), assessed at the unit level, are independently associated with the quality of patient care (hospital-acquired infections) and the recruitment and retention of nurses (RN orientation hours, unit RN vacancy and RN recruitment rates). These findings support two of the theory’s propositions. In the final model, the nurse staffing concept was associated with nursing human capital (measured as proportion of RNs with degrees), and the nursing human capital (proportion of RNs with degrees) was directly associated with the quality of patient care (rate of hospital-acquired infections). Nursing human capital measured as the proportion of RNs with specialty certification was directly associated with the quality of patient care (rate of hospital-acquired infections) and recruitment and retention outcomes (RN recruitment rate). Nursing human capital measured as RN unit tenure and RN professional experience were directly related to RN recruitment and retention outcomes.

In this chapter the participation and response rates, as well as characteristics of the participating units are reviewed to determine generalizability of the results. The study findings are discussed in relation to previous research and the propositions of the middle-range theory of nursing intellectual capital. Implications for the theory, research, practice and policy are presented.
Participation and Response Rates
This study required the participation of several hospitals. The hospitals’ participation involved the extraction of data from several departments and the survey completion by unit managers within each hospital. The following subsection presents the discussion regarding the hospital participation rate, hospital department response rate, and unit manager response rate and how they affected the representativeness of the study sample.

Hospital participation rate.
The hospital participation rate for this study was affected by the hospitals’ ability and willingness to use hospital resources to provide the requested data. Thirteen hospitals were approached to participate and 6 hospitals agreed. Seven hospitals declined participation because it was not feasible for the hospital to provide the requested data for two reasons, the hospital did not have the data or the means (human resources, information systems) to extract them. A few of the hospitals expressed hesitation to become involved in the study as they had just completed data collection for a large multisite study which involved similar data extraction methods. They explained that their participation in the previous study was time consuming and fatiguing for their staff; thus at this time they could not allocate the human resources (department or unit managers) needed to extract the data for the current study. Nonetheless, similar to the study by McGillis Hall et al. (2006) the participating hospitals for this study were university affiliated teaching hospitals located in major urban areas of Ontario and Quebec, Canada.

Hospital department response rate.
The participating hospitals’ departments had a response rate of 100%. Since the hospital departments were consulted prior to data collection to determine if they had the data as well as the resources and systems required to provide the data, the 100% response rate for the current study is to be expected. Comparable hospital departmental response rates were reported by McGillis Hall et al. (2006) who used similar sampling techniques to acquire data from hospital databases.
**Unit manager response rate.**

The response rate for unit managers was slightly higher (71%) than reported by previous studies that surveyed unit managers (58%: Laschinger et al., 2008). For this study the unit manager survey was distributed in-person by the investigator to the unit managers of all units that met the eligibility criteria. Delivering the survey in-person has been found to produce a return rate of 75% (Dillman, 2007). In addition, the initial survey distribution was followed with specific steps (incentives, reminder emails, replacement surveys) found to increase survey response rates (Dillman). These two strategies together may have contributed to the high response rate for unit managers. It should also be noted that the previous large multisite study could have created a response burden which may have negatively affected the unit managers’ decision to complete and return the survey. The other possible reasons for the unit managers failing to return the surveys include the unit manager did not receive the survey (in-person or via email), was on vacation during data collection period, had recently resigned and their replacement had not been found, or was unfamiliar with the information requested on the survey.

**Sample Size**

The six participating hospitals provided data for 147 units. However, due to missing and skewed data 56 (38%) units were eliminated from the analysis. The final sample size of 91 inpatient units is comparable to that reported in other studies that used the inpatient unit as the unit of analysis (Blegen et al., 1998a, Blegen & Vaughn, 1998b, Blegen et al., 2001, McGillis Hall et al., 2006). A sample size of 91 units allowed for 6.5 cases per variable which is within the guidelines set by Schumacker and Lomax (2004) for establishing adequate power when testing a model comprised of latent and observed variables.

**Unit Characteristics**

The unit of analysis for this study was the inpatient unit. A qualitative comparison of the study sample to previous research that included inpatient units from Canadian hospitals was completed to determine the representativeness of the sample to the population of interest. The current study’s sample included adult medical-surgical, critical care, obstetrics, pediatrics, psychiatry, complex continuing care and long term care units; which are representative of
inpatient units within Canadian hospitals. Although the study sample included a large percent of long-term-complex continuing care units, its composition is similar to the sample selected in a recent study by McGillis Hall et al. (2006); the latter sample was comprised of inpatient medical-surgical, long term care and complex continuing care units from a variety of sizes of Canadian hospitals. Yet, the current study’s sample does differ slightly as it includes pediatric, adult critical care, psychiatric and obstetrical units.

Besides unit type, the RN age and patient length of stay data were collected to describe the study units. The majority of the RNs employed on the study units were between 41-50 years of age \( M = 42 \) which is consistent with the mean RN age \( M = 45.1 \) reported by CIHI (2010). As mentioned earlier, the patient length of stay varied greatly, due to the inclusion of long term-complex continuing care units where the patients hospitalizations are long \( \text{Range} = 1.5-1080; \text{Median} = 8.70; M = 98; \text{SD} = 245 \). By including a wide variety of inpatient units, the current study’s results can be generalized to most inpatient units (with a length of stay greater than 24 hours and patient age greater than two years) located within university affiliated teaching hospitals. The findings are also generalizable to inpatient units within publicly funded hospitals in urban areas able to provide the requested data.

### Nurse staffing variables.

The results of this study indicated that on average the inpatient units had nurse staffing of 7 HPPD, a skill-mix of 67% RNs and a RN-to-patient ratio of 1 RN to 4 patients. The HPPD and skill-mix for this study were much lower than those reported by Blegen et al. (1998a, 1998b). The inconsistency could have occurred because of the types of units included in the 2 studies; the current study included long term care and complex continuing care units, whereas Blegen et al. selected acute care units only. The inclusions of long term-complex continuing care in the current study may have contributed to an overall lower mean for HPPD and skill-mix as these types of units provide less HPPD, and have a nursing staff that has a lower proportion of RNs than other types of units. Another possible explanation for the inconsistency relates to the context in which the study was conducted, where the studies by Blegen et al. report on data collected more than 10 years ago in the United States. This suggest that in recent years the staffing patterns for inpatient units may have changed by
reducing the hours of nursing care provided per patient per day and the type of health care professionals providing the care. Also the source of hospital funding (public vs. private) may have differed and could have led to the inconsistent findings since for-profit hospitals have been reported to use significantly less RN staffing (i.e. fewer RN productive hours) than nonprofit hospitals (Seago, Spetz & Mitchell, 2004). The RN-to-patient ratio was slightly lower than the nurse-to-patient ratio reported by McGillis Hall et al. (2006) who presented data from similar types of Canadian hospitals and units as this study. This could be due to the formula used to generate the ratio. McGillis Hall included LPNs in addition to RNs to compute a nurse-to-patient ratio whereas this study used RNs only to compute a RN-to-patient ratio. Furthermore, the difference in the patient ratios reported in the two studies could reflect the characteristics of the units; those included in current study provide care to patients that have medical conditions of higher acuity and hence require higher levels of RN care than the units in McGillis Hall’s study. In summary, since researchers have used various variables and empirical indicator definitions to measure nurse staffing, the lower staffing levels reported in this study may be not only due to the type of units that participated in the study but also the empirical indicators used to measure nurse staffing.

The result of between-unit comparisons indicate that the specialty units demonstrated higher nurse staffing than medical-surgical and long term-complex continuing care units. This finding signifies that specialty units (pediatric, adult critical care, psychiatric and obstetrical) offer higher levels of RN staffing. This is comparable to the trend found in a study conducted by Welton et al. (2006) who reported high RN-to-patient ratios and HPPD for critical care units. The high HPPD and RN-to-patient ratio suggest that RNs employed by specialty units care for fewer patients per shift which permits them to provide more hours of care in order to address the multiple needs and manage the complex conditions of the patients admitted to these types of units.

**Nursing human capital variables.**

The nursing human capital variables collected for this study included the proportion of RNs with degrees, proportion of RNs with specialty certification, hours of CE attended by RNs, mean years of RN professional experience and mean years of RN unit tenure. The findings
revealed that the study units on average reported approximately one-third of the RNs had bachelor degrees or higher, while 10% had specialty certification. The managers reported that on average the unit RNs participated in a high number of CE hours and RNs were also experienced, having worked as RNs for approximately 12 years and on the study unit for greater than 5 years. Since previously many of these variables have not been reported for Canadian inpatient units, direct comparison could not be made for all of the variables. However when possible these RNs’ characteristics were examined in relation to national data for representativeness. The comparison revealed that the proportion of RNs with degrees is consistent with the CIHI report (2010) which indicates that 35% of Canadian RNs have bachelor’s degrees. The range in values (0-100%) varied considerably across units indicating that there were some study units that had no RNs with university degrees whereas others had only RNs. This range is reflective of the types of units selected for this study, where critical care units tend to hire an all-RN staff with the required knowledge and skills to function competently in this clinical setting, and long term care units may employ a low number of RNs and RNs without degrees.

Approximately 10% of RNs on the study units had specialty certification, which is slightly lower than the estimated national average of 17.7% (CNA, 2007). The range in values for study units demonstrated that not all units had RNs with specialty certification. This is consistent with the types of units selected, which included a large number of units that do not have an associated specialty certification, such as complex continuing care (CNA, 2010).

An examination of the values for the hours of CE attended by RNs indicates a wide range in the unit managers’ reports. The range in responses could reflect variability between the two provinces and units. In Quebec hospitals provide 1-2 years unpaid study leaves for RNs to pursue academic education whereas hospitals in Ontario do not. Although a CNA and CASN joint policy states that ‘employers are responsible for removing barriers for those that wish to attend educational programs, such as providing study leaves and partnering to provide funding” (2004, p.1) the availability of unpaid study leaves is not mandated in Ontario. Also, employers may not be aware of all of the unpaid hours RNs allocate per year to advancing their academic education. Nurses attend various forms of CE offered within and outside the
hospital, and no unit within this study was able to produce data that represents a complete account of the unpaid hours of CE attended by the RNs on their units.

On average, RNs on the participating units had a mean professional experience of 12 years, which was slightly lower than the 16.5 years reported by Meyer et al. (2009). This may be because Meyer et al. collected data from LPNs as well as RNs. LPNs require less years of formal education which could account for the higher years of work experience. The length of service RNs devote to inpatient units (RN unit tenure rates) has not previously been reported for Canadian inpatient units for RNs. However an American study (Blegen & Vaughn, 1998b) which reported lower professional experience rate found similar length of service (RN unit tenure rates) to those found in this study. The discrepancies in the values could be attributed to the difference in timeframe for the data collection as Blegen et al. (1998a, 1998b) obtained data more than a decade earlier.

The nursing human capital variables in general were higher for specialty units. On average, more RNs on specialty units had degrees, certification, and professional experience than RNs on medical-surgical and long term complex continuing care units. This suggests that more RNs employed by specialty units participate in formalized CPD such as academic education and specialty certification than RNs employed by adult medical-surgical and/or long term-complex continuing care units. This may be because the RNs working for specialty units were more highly experienced than RNs working for other types of units and therefore had more time to acquire degrees and were eligible to apply for specialty certification. Since RNs employed by medical-surgical units in this study were less professionally experienced this finding could reflect that they have not had the time to complete their academic degrees or acquire the experience to be eligible to apply for specialty certification. Although not as many RNs employed by medical-surgical units have degrees or specialty certification they do participate in a higher number of hours of CE than RNs employed by specialty and long term complex continuing care units. The higher hours of CE attended by RNs for the medical-surgical units may reflect the RNs participation in the general in-service education which is essential for novice nurses, or they are in the process of completing academic degrees.
**Employer support for nurse CPD variables.**

The findings related to the variables for the employer support for nurse CPD concept suggest that Canadian hospitals provide support for RNs to develop their knowledge and skills. However the amount of support the organizations or units provide per RN does not appear to be standardized. Determining if the results represent units within Canadian hospitals proved to be difficult as no unit level studies could be located that specifically reported findings for these variables. Still these findings are encouraging as they indicate that employers are assisting nurses with developing their knowledge and skills after they enter the profession.

The values for the variables for employer support for nursing CPD concept differed slightly across unit types. The RNs on medical-surgical units received slightly more time off to learn than RN employed by long term care units and specialty units. More RNs employed by specialty units received funding from their employer to attend CPD than RNs employed by the other types of units. Yet, RNs working for medical-surgical and specialty units are replaced more often when they are away from the unit to learn than RN employed by long term care-complex continuing care units. Long term-complex continuing care units had a slightly higher educator-to-RN ratio. These findings suggest that RNs working in specialty units and medical-surgical units must acquire more knowledge and skills to remain clinically competent than RNs working in long term-complex continuing care units. The findings also suggest that employers use a variety of methods to support RNs ongoing learning needs such as providing clinical educators or consultants.

**Nursing structural capital variables.**

The results pertaining to the nursing structural capital variables indicated the overwhelming majority of units had practice guidelines for the prevention of patient falls, medication errors, and hospital-acquired infections. The availability of guidelines for the prevention of medication errors and hospital-acquired infections were consistently available across unit types. However the guidelines for the prevention of patient falls were less prevalent for specialty units than other types of units. This finding is most likely due to the type of units included in the specialty unit category. Pediatric, critical care and psychiatry units often care for patients at low risk for falling as they are either do not ambulate unsupervised
(pediatrics), confined to bed (critical care), physically healthy (psychiatric); therefore it is understandable that these types of units wouldn’t make it a priority to have practice guidelines for the prevention of patient falls available to the nursing staff. Nonetheless, the availability of practice guidelines on the participating units is encouraging as they are another method for facilitating the uptake of knowledge into practice and guiding nurses in the provision of safe care.

**Quality of patient care outcomes.**

The rate of adverse events for the quality of patient care outcomes (patient falls, hospital-acquired infections and medication errors) have not been previously reported for Canadian inpatient units. The patient fall and medication error rates found in this study are slightly higher than those identified by Blegen et al. (1998a, 1998b). The differences in these rates could be related to the differences in methods used to identify and report medication errors and formula used to estimate the rate. Nonetheless, the rates of the adverse events observed in this study may be related to the types of units selected. For instance, patient falls could be high since complex continuing care units were included whereas the medication error rates could be high since the study included units that care for patients with high acuity or complex medical conditions such as critical care units. The high patient fall and medication error rates could also reflect that the units’ culture encourages the reporting of medication errors (Wakefield et al., 2001) and/or patient falls. It can also imply that the type of inpatient unit may influence the prevalence of or the patients’ risk for experiencing specific types of adverse events (medication error or patient falls). It therefore be surmised that nurses employed on these units are more aware of the potential for the specific unit related adverse event incidents and thus more likely to detect and report their occurrence. As such nurses employed by the specialty units included in the analysis may have voluntarily reported more medication errors while long-term complex continuing care units may have voluntarily reported more patient falls, than nurses working for units sampled in other studies (Blegen, 2006; Mark & Belyea, 2009). However, additional research that focuses on the influence of unit type on the reporting of adverse events is indicated to empirically substantiate this suggestion.
The current study used the hospital infection control databases to extract the number of MRSA, C-Difficile and VRE infections per unit to compute a hospital-acquired infection rate per 1000 patient days. Unit rates for this empirical indicator have not been reported in the literature; however Blegen et al. (1998a) reported a unit rate of 6 infections (urinary and respiratory combined) in 1,000 patient days. The higher hospital-acquired infection rate reported by Blegen et al. may be due to the type of infections included to define the indicator, the indicators used to identify a case, or to the source for obtaining pertinent data (available database vs. chart extraction).

The variables for quality of patient care outcomes varied by unit type. Long term care/complex continuing care units reported fewer medication errors than medical-surgical units or specialty units. This difference reflects the high length of patient stay on long term-complex continuing care units and the limited change in medications for patients admitted to these units. Therefore the RNs on these units may be more familiar with their patients’ medications and less likely to make errors. The patient fall rate for long term-complex continuing care units was also higher than for medical-surgical units and specialty units. As discussed earlier, this is to be expected, as long term-complex continuing care patients are mobile and at the same time more vulnerable to falling than patient hospitalized on the other types of units. Conversely, the hospital-acquired infection rate was lower for long term-complex continuing care patients. This could be related to the lower number of health care providers the patients come in contact with (as indicated by the lower HPPD) or that the patients on these units are more clinically stable and less susceptible to infections.

**RN recruitment and retention outcomes.**

The RN recruitment and retention variables observed on the participating units were low implying that these units had high RN retention. However the definitions of the empirical indicator were different than those used in other studies (O’Brien-Pallas et al., 2006). For this study the empirical indicators were designed to reflect the units’ ability to recruit and retain RNs and to have a common metric to ensure comparability among units, hospitals and provinces (Hayes et al., 2006). The definitions alone could have resulted in the low rates found in this study. For example in this study RN turnover reflected the number of voluntary
separations from permanent RN FTEs (not number of RNs) thus excluding separations created by maternity, sick or study leaves of absences and retirement. This differs from the empirical indicators used in previous studies (O’Brien-Pallas et al.) which often include RNs and LPNs to calculate a nurse turnover rate, and also include the separation of available and casual staff.

This study’s findings for RN orientation hours, RN vacancy rate and RN recruitment have not been reported for Canadian inpatient units therefore their representativeness of the population of interest could not be evaluated. However the empirical indicators used to calculate the study variables also involved RN permanent FTEs which may have led to the low rates found in this study.

There was minimal difference among unit types for the RN recruitment and retention variables. The long term-complex continuing care units reported slightly lower RN turnover and recruitment rates than medical-surgical units and specialty units indicating that there was higher RN retention on medical-surgical and specialty units than on long term-complex continuing care units.

In summary, most of the units’ characteristics were consistent with findings from previous research. When inconsistencies were noted they were determined to occur due to differences in the variable definition, empirical indicators, or unit types across studies; and the previous studies were dated. Nonetheless, the current study’s descriptive findings indicate that the sampled units are representative of and the study results are generalizable to most types of units embedded within university affiliated teaching hospitals. The findings are also generalizable to inpatient units within publicly funded hospitals in urban areas.

**Bi-variate Relationships between the Individual Indicators**

The bi-variate relationships among the individual indicators of concepts proposed in the nursing intellectual capital theory were examined prior to model testing. The statistically significant relationships are discussed below per theory propositions, as they are comparable to those examined and reported in the literature.
**Nurse staffing and nursing human capital.**
The results of the bi-variate correlation analysis suggested that inpatient units with high hours of nursing care per patient per day (HPPD) and high skill-mix had a high proportion of RNs with degrees. Units with high skill-mix also had RNs who participated in high number of CE hours. Thus when units employ a high number of RNs, the unit skill-mix is high, and the proportion of RNs with degrees is high. Also, when the nursing staff has a high proportion of RNs, there are more RNs available to participate in CE. Since units with high levels of nurse staffing (HPPD and skill-mix) usually care for more patients that require complex nursing care, such as critical care or pediatric units included in this study, these types of units require a large number of nurses with advanced knowledge.

**Employer support for nurse CPD and nursing human capital.**
Units that employ low number of RNs with degrees, such as long term-complex continuing care units, provide RNs with more educational support in the form of clinical educators. This implies that unit managers may compensate for the lower levels of RN knowledge (proportion of RNs with degrees) by allocating more clinical educators to support the RNs’ clinical decision-making. Additionally, when a higher number of RNs receive funding to participate in CPD, the RNs of the unit participate in a higher number of hours of CE. This finding supports the results from previous research in which nurses identified financial constraints as a barrier to their participation in CE activities (Cullen, 1998; Smith, 2004; Penz, D’ Arcy, Stewart, Kosteniuk, Morgan & Smith, 2007). Thus, when nurses are provided with funding to advance their knowledge and skills, they participate in more CPD.

**Nursing human capital and patient outcomes.**
Units with high proportion of RNs with degrees had low patient fall rates, whereas units with high proportion of RNs with specialty certification had low rates of patient falls and low rates of hospital-acquired infections. These findings are consistent with previous research which found the proportion of certified nurses on a unit was inversely related to frequency of patient falls (Kendall-Gallagher & Blegen, 2009). These results suggest that units that employ a high proportion of RNs with degrees and/or specialty certification, such as critical or obstetrical units, may have a more knowledgeable RN staff which is associated with better
quality of patient care of the unit. Yet, specialty units such as critical care and obstetrical units also admit patients who are at low risk for falling, which may explain the lower fall rates on specialty units.

**Nursing structural capital and patient outcome variables.**
The availability of practice guidelines for the prevention of adverse events (patient falls, medication errors and hospital-acquired infections) was not empirically related to the unit rate of adverse events (patient falls, medication errors and hospital-acquired infections). The reason for these nonsignificant correlations may be the low variability observed in the reported availability of practice guidelines for prevention of patient falls, medication errors and hospital-acquired infections; almost all units in this study reported having the practice guidelines available on their unit.

**Nursing human capital and RN recruitment and retention outcomes.**
Significant relationships were found between proportion of RNs with specialty certification and RN recruitment rate; RN professional experience and proportion of RN hours used for RN orientation; RN unit tenure rate and proportion of RN hours used for RN orientation; and, RN vacancy rate and RN recruitment rate. These associations indicate that units with high proportion of RNs with degrees, specialty certification and experience (RN professional experience and RN unit tenure) recruit and retain RNs.

In summary, many of the bi-variate correlations between empirical indicators of concepts were consistent with specific propositions of the nursing intellectual capital theory and with available literature. Exploratory factor analysis was conducted to determine if empirical indicators measure their respective concepts identified in the middle-range theory of nursing intellectual capital: nurse staffing, employer support for nurse CPD, nursing human capital and nursing structural capital. The next section discusses the results for the factorial structures of the concepts.

**Factorial Structure of the Concepts**
The factorial structure for the nurse staffing concept held. This means that the conceptual and operational definitions of nurse staffing as proposed by the nursing intellectual capital theory
were supported. Conceptually, nurse staffing is defined as the amount of nurses available on a unit to provide nursing care. Empirically nurse staffing is operationalized by the combination of HPPD (hours provided to patients per day), skill-mix (proportion of nursing staff that are RNs) and RN-to-patient ratio (number of patients RNs care for per shift).

Although other researchers have used structural equation modeling to investigate the association of individual nurse staffing indicators such as skill-mix with patient outcomes (Mark, Sayler, Wan, 2003), this is the first time that nurse staffing has been conceptualized as an independent entity or unified whole, and measured as a concept. As such, this concept provides important new information for unit managers that can be used when planning the staffing of their units. It implies that one staffing indicator may not comprehensively measure the amount of nurse staffing available per patient but rather it is the combination of indicators (HPPD, skill-mix and RN-to-patient ratio) that determines nurse staffing.

The factorial structure for the employer support for nurse CPD and nursing human capital concepts did not hold. The empirical indicators of nurse CPD (proportion of RNs received financial support, time off to learn, ratio of clinical educator-to-RN, percent of time replaced) and the nursing human capital (proportion of RNs with degrees, proportion of RNs with certification, hours of CE attended by RNs, RN professional experience, RN unit tenure) concepts did not appear to accurately reflect their related concepts. The possible reasons for this finding include the (a) quality of the data, as many managers did not keep formal records of the data required to compute the requested variables, (b) empirical indicators used to measure the concept did not capture or fit the concept well, and (c) empirical indicators may measure more than one concept as the factorial structure for the nursing human capital concept suggested. Additional theoretical and empirical work is warranted to refine the theoretical and operational definitions of these concepts such as including RN expertise as an attribute of nursing human capital, and refining the empirical indicator for employer support for nurse CPD that measures the financial assistance given to nurses to attend CPD to reflect the amount of financial investment provided per RN.

The factorial structure for nursing structural capital concept including the empirical indicators of availability of guidelines for the prevention of medication errors, falls, and
hospital-acquired infection did not hold. This may be due to the limited variability in these variables; where the majority of units reported having the guidelines on their units. In future work, alternative empirical indicators for the nursing structural capital concepts such as those that reflect the use of practice guidelines for the prevention of adverse events or the availability of other forms of nursing structural capital such as information systems, evidence-based literature should be investigated to determine if they better measure or fit the concept.

**Study Hypotheses**

SEM was used to simultaneously test the relationships among the concepts or their indicators as proposed by the nursing intellectual capital theory. Below the findings pertaining to each study hypothesis are discussed, followed by a discussion of the whole model.

Hypothesis 1: Nursing units with high levels of nurse staffing will have high levels of human capital, which in turn, will have high levels of quality of patient care and high recruitment and retention outcomes was partially supported.

Hypothesis 1 was tested by determining the relationships among the nurse staffing concept, individual indicators associated with the nursing human capital concept, and the rates of adverse events and nurse recruitment and retention. Nurse staffing was directly associated with a high proportion of RNs with degrees. This moderate positive association implies that units with high levels of nurse staffing have a high proportion of RNs with university-level degrees. The relationships between nurse staffing and the other variables reflecting the nursing human capital concept, that is, proportion of RN with specialty certification, hours of CE attended by RNs, mean years of RN professional experience and mean years of RN unit tenure were not statistically significant. These findings partially support the study hypothesis that nurse staffing is associated with nurses’ knowledge, skills and experience, specifically the academic preparation of the RN staff.

This is the first study to investigate the relationship between nurse staffing and nurses’ knowledge, skill and experience. Although this relationship was not investigated in previous nursing research it is consistent with studies investigating intellectual capital within business,
where it was noted that the depletion of human capital (reflected as nurse staffing in the current study) is negatively associated with the effective use of human capital (Bontis & Fitzenz, 2002). The current study’s finding that nurse staffing levels are associated with the proportion of RNs with degrees suggests that (a) nurse staffing is a concept, (b) the nurse staffing concept includes variables specific for measuring the amount of nurses available to provide care to patients and not the credentials or qualifications (academic preparation, certification) of the RNs that provide the care, and (c) the amount of nurse staffing may be associated with the amount of nursing knowledge available on a unit, as units with high nurse staffing have high RN skill-mix, low RN-to-patient ratio and RNs with high levels of academic preparation (degrees).

Similar to previous research, but not hypothesized for this study, nurse staffing had a direct relationship with patient outcomes (Blegen et al., 1998; 2001; Van den Heede et al., 2009; Whitman, Kim, Davidson, Wolf & Wang, 2002). However contrary to some prior research, nurse staffing in this study predicted significantly lower rates of patient falls but significantly higher rates of hospital-acquired infections and medication errors. The discrepancies in the direction of the relationships between nurse staffing and the patient outcomes could be the result of nurse staffing being represented as a concept which was simultaneously measured with three nurse staffing indicators (HPPD, skill-mix, RN-to-patient ratio). This differs from other studies in which various empirical indicators were used, independently, to measure nurse staffing. By conceptualizing nurse staffing as a latent variable this study introduces a comprehensive method that uses not only hours of care available per patient but also the amount of RNs available on the unit to provide patient care. Measuring nurse staffing as a concept may help researchers begin to reconcile the different measures used to capture nurse staffing and thus conflicting results that are currently reported in nurse staffing research.

For the current study nurse staffing was significantly associated with higher hospital-acquired infections. Although this finding is counterintuitive, it is similar to that of Blegen et al. (1998) who reported that units with more acutely ill patients had higher HPPD and higher rates of hospital-acquired pneumonias and urinary tract infections. Since this study found that specialty units had higher nurse staffing than medical-surgical or long term care-complex
continuing care units it could be surmised that high levels of nurse staffing reflects units that care for high acuity patients. The relationship between high levels of nurse staffing and high hospital-acquired infection rate could indicate that patients hospitalized on specialty units are more acutely ill thus they are exposed to high number of health care providers and undergo more interventions which may put the patients at higher risk for acquiring infections than patients that are hospitalized on other types of units.

Another explanation for the unexpected results could be the homogeneity of the setting used for this study as all of the participating hospitals were university affiliated teaching hospitals which have been reported to have higher rates of hospital-acquired pneumonia, urinary tract and wound infections (Needleman et al., 2001). Other organizational traits such as size, location, funding, could have contributed to the finding that higher levels of nurse staffing influence higher rates of hospital-acquired infections (Needleman et al., 2001). Additionally it could also be argued that despite that the levels of nurse staffing reported in this study were comparable to other studies, perhaps the level of nurse staffing was not high enough to avert the type of hospital-acquired infections measured in this study (combination MRSA, C-Difficile, VRE infection).

Patients who are hospitalized on units that provide high nurse staffing such as specialty units (pediatric, adult critical care, psychiatric and obstetrical) may also receive more medications. Although this study did not collect data on the number of medications provided per 1000 patient days, or the number of medication errors per doses of medications administered on the unit, as other studies have (Blegen et al., 1998; 2001), it could be surmised that when nurses care for sicker patients they administer a higher number and medications that require complicated regimens (such as chemotherapy or vasopressors) than nurses who care for patients with non-acute or less complex conditions. Since the medication error rate for this study used data from incident reports, this finding could also demonstrate that nurses on units with high levels of nurse staffing, such as specialty units, report more medication errors.

The relationship found in this study between high levels of nurse staffing and low rates of patient falls could reflect that the units in this study admit patients who require high levels of nursing care. Often patients that require high levels of nursing care such as those cared for in
specialty units are immobile and confined to bed. Therefore they are at lower risk for falling since many do not ambulate, transfer to a chair or use the toilet without direct supervision. Yet, the findings could also signify that units which provide high levels of nurse staffing have high numbers of health care providers available to supervise and assist patients during ambulation, thus preventing patients from falling.

Whereas the nurse staffing concept was directly associated with patient outcomes (low patient falls, high medication errors and high hospital-acquired infections), it was also indirectly associated with low hospital-acquired infections through the proportion of RNs with degrees. The testing of the mediation model did not support a complete mediating relationship as there remained a statistically significant direct path between nurse staffing and hospital-acquired infections when the paths between the nurse staffing (independent variables), proportion of RNs with degrees (mediating variable) and hospital-acquired infection rate (dependent variable) were controlled. Partially mediated relationships occur when the path from the independent to the dependent variable is reduced in absolute size but is still different from zero when the mediator is controlled by constraining the regression paths between the independent and mediating variable and the mediating and dependent variables to 1 (Baron & Kenny, 1986). This finding indicates that the relationship between nurse staffing and hospital-acquired infections is partially reduced by the proportion of RNs with degree. This partially mediated relationship begins to explain the mechanisms underlying the association of nurse staffing with better patient outcomes. Because the work environment is complex it is unrealistic that a single mediator could completely explain the relationship between nurse staffing and hospital-acquired infections or other patient outcomes. Several researchers have acknowledged the importance of identifying possible mediators of nurse staffing relationships with patient outcomes (Donaldson, Brown, Aydin, 2001; Mark et al., 2004). Variables that have been suggested as possible mediators of the relationship between nurse staffing and quality of patient care include autonomy and nursing empowerment (Richardson & Storr, 2010), control over practice (Kramer & Schmalenberg, 2002), nursing leadership (Laschinger & Leiter, 2006; Wong & Cummings, 2007), leader-member exchange (Mark et al., 2004), and interprofessional collaboration (Boyle, 2004). However, additional theoretical and empirical work is required to identify if these or other
contextual factors partially or completely mediate the relationship between nurse staffing and patient outcomes.

Nursing human capital (proportion of RNs with degrees, proportion of RNs with specialty certification, hours of CE attended by RNs, mean years of RN professional experience, mean years of RN unit tenure) was directly associated with the quality of patient care (patient falls, medication errors, and hospital-acquired infection rates) and recruitment and retention of registered nurses (proportion of RN earned hours used for orientation, RN recruitment, RN turnover, RN vacancy rates). As hypothesized, units with a high proportion of RNs with degrees had low rates of hospital-acquired infections, and units with high proportion of RNs with specialty certification also had low rates of hospital-acquired infections. These moderate relationships support the hypothesis that nursing units with high levels of human capital (proportion of RNs with degrees and proportion of RNs with specialty certification) have high quality patient care (low rates of hospital-acquired infections) and the middle-range theory proposition that units with higher nursing human capital (a more knowledgeable, skilled and experienced nursing staff) have high-level quality care. These results are also consistent with previous research that found a significant association between the proportion of RNs with degrees (nurses’ knowledge) and lower hospital-acquired pneumonias and urinary tract infections (Blegen et al., 2001) and is similar to Bontis and Fitz-enz’s (2002) findings showing significant associations between high levels of human capital and high organizational performance in the field of business.

As hypothesized some of the variables for nursing human capital concept were associated with RN recruitment and retention outcomes. Specifically, high proportion of RNs with specialty certification was significantly associated with low recruitment rates. Experience in the form of high levels of RN unit tenure was also moderately associated with low RN vacancy and low RN recruitment rates, whereas units with high levels of RN professional experience reported using a small proportion of their RN earned hours to orient new RNs. These findings support the study hypothesis that units with higher levels of nursing human capital have higher RN recruitment and retention outcomes than units with lower levels of nursing human capital. These results are similar to those of Rondeau, Williams and Wagner
(2009) who found that organizations reporting high RN turnover had low RN human capital, implying that organizations that invest in nursing human capital retain a large number of RNs. They are also comparable to the findings from the intellectual capital literature which reports that a high amount of human capital is associated with high organizational performance (Bontis & Fitz-enz, 2002). Despite nurses’ reports that they are attracted to organizations that have adequate staffing and a competent nursing staff (Kramer & Schmalenberg, 2004b), this study found no relationship between nurse staffing and the variables associated with the recruitment and retention of RNs. This finding indicates that the amount of nurse staffing does not seem to be indirectly related to the RN recruitment and retention of a unit, as hypothesized.

Hypothesis 2: Nursing units with high levels of employer support for nurse CPD will have high levels of human capital, which in turn, will have high levels of quality of patient care and high recruitment and retention was not supported.

As reported earlier the factorial structures for the concepts of employer support for nurse CPD and nursing human capital did not hold. Therefore the individual indicators reflecting each concept were included in the analysis, and their relationships with the outcomes were not congruent with the study propositions. No statistically significant relationships among the variables were detected; thus the study hypothesis was not supported. These findings differ from those observed by Bontis and Fit-enz (2002). These researchers found that organizational investment in training and development leads to the development of human capital (Bontis & Fit-enz). The inconsistent results could be attributed to differences in study population and/or instruments used to measure the concepts in the two studies. The instrument used by Bontis and Fitz-enz measured the average financial amount the organization spent on training and development; whereas this study used non-financial data, such the amount of human resources available (i.e., clinical educators to RN) on the unit to support the development of nursing human capital. Refining the empirical indicators for the employer support for nurse CPD to reflect the amount of financial investment organizations allocate to the development of nurses’ knowledge and skills in future studies is suggested. These changes would be consistent with the intellectual capital research as well as a recent
study by Rondeau et al. (2009) who found that organizations that made greater investments in nursing training and development and reported higher human capital had lower levels of RN turnover.

As mentioned previously the factorial structure of the nursing human capital concepts did not hold. Therefore, it was not possible to test the hypothesis that employer support for nurse CPD concept and the quality of patient care and RN recruitment and retention outcomes are mediated by the nursing human capital concept. In addition none of the individual indicators was associated with any of the nursing human capital indicators; therefore the hypothesis of an indirect relationship between employer support for nurse CPD and RN recruitment and retention outcomes was not supported.

Hypothesis 3: Nursing units with high levels of structural capital will have high levels of quality of patient care was not supported.

The factorial structure for the nursing structural capital concept did not hold. In addition, none of the empirical indicators of the nursing structural capital concept, availability of practice guidelines for the prevention of patient falls, medication errors and hospital-acquired infections was significantly associated with any of the patient outcomes identified for this study. These findings are contrary to the reports in intellectual capital literature where structural capital has been found to be directly and positively related to business performance (Bontis, 1998; 1999) and the nursing literature which indicate that the use of practice guidelines can improve patient care (Thomas et al., 2002). Although Bontis (1998; 1999) found significant associations between structural capital and business performance they defined structural capital as knowledge that can be sold, reproduced, patented, or copyrighted such as inventions or technologies. The theory that framed this study proposes that practice guidelines are a form of structural knowledge and their use is related to lower rates of adverse events. However, the availability of guidelines may not capture nurses’ application of knowledge in practice. Therefore, since Thomas et al. reported nurses’ use of practice guidelines can lead to better fall prevention, future research could focus on investigating if nurses’ use or if their adherence to practice guidelines actually prevents the occurrence of adverse events.
Overall the final model demonstrates that nursing knowledge, skills and experience influence the quality of patient care and RN recruitment and retention of inpatient units. Specifically, the model reveals that it is the combination of the attributes of nursing human capital (academic preparation, specialty certification and experience) that are associated with better quality patient care. Interestingly, the model reveals contradictory relationships between nurse staffing and patient outcomes measured as adverse events. Nurse staffing measured as the combination of HPPD, skill-mix and RN-to-patient ratio, and the inclusion of the other variables in the model may have contributed to the counterintuitive relationships found between higher nurse staffing and higher medication error rates, and higher hospital-acquired infections.

In summary, conceptual and methodological factors may have influenced some of the results. The conceptual factors were derived from the literature used to support the derivation of the intellectual capital theory to nursing and the data available to empirically measure the concepts. The derivation of the theory from the field of business required a systematic review of the empirical literature related to nurses’ knowledge, skills and experience (Walker & Avant, 2005). The process of theory derivation uses the available empirical evidence which restricts the variables that can be included in the theory (Walker & Avant). Additionally, the empirical indicators used for some of the variables could have affected the congruency between the concepts and their respective indicators as previous research has found the definition of the empirical indicator used to measure a construct can affect the direction and magnitude of its relationships with other variables (Mark, Hughes & Bland Jones, 2004). Repeating the study with different empirical indicators for the concepts that did not have valid factorial structures may provide a fuller test of theory.

Methodologically the findings may have been affected by the study’s level of analysis, and measurements. The level of analysis for this study was the inpatient unit. The intellectual capital research to date as well as the study by Rondeau et al. (2009) posited intellectual capital as an organizational construct. Although theoretically it is reasonable to assume that nurses’ knowledge, skills and experience are most influential on patient outcomes at the unit level, the level of analysis for this study may have contributed to the inability to find
statistically significant associations among the concepts and their indicators as proposed by the theory. Also, the measurement of knowledge, skills and experience can be complex. The attempt to quantitatively measure the organizations’ nursing human capital is inherently difficult as it is considered to be an intangible asset of an organization; therefore it may not be directly measurable (Stewart, 1997). Although researchers from the field of business have reported success in indirectly measuring intellectual capital (Bart, 2001; Bontis, 1998; 1999; Bontis & Fitz-enz, 2002; Youndt et al., 2004) and finding empirical support for the relationships among the theory’s concepts (Bontis; Bontis & Fitz-enz; Youndt et al.), their measures differed from the measures used in this study. The intellectual capital researchers surveyed CEOs to solicit their perceptions of their organization’s intellectual capital. This study is the one of a very few to apply intellectual capital theory to hospitals (Habersham & Pier, 2003) or nursing (Rondeau et al., 2009), and use empirical indicators as proposed by intellectual capital and nursing researchers (Edvinsson & Malone, 1997; Stewart, 1997, 2001; McGillis Hall, 2003; Lankshear, Sheldon and Maynard, 2005) to measure the concepts. Consequently, it remains uncertain if using empirical indicators is the best method for indirectly measuring nursing intellectual capital within hospitals or if there are other measures that would better capture the concepts.

**Limitations of the Study**

Limitations of this study include sample selection bias and the sources of data used to measure some of the variables. A potential selection bias may have occurred due to the characteristics of the hospitals and units that were included in the study. Since the participating hospitals were university affiliated teaching hospitals located in large urban areas of Canada, community, smaller or rurally located hospitals are not represented as they did not have the requested data, capacity (human resources, information systems) or administrative support to use hospital resources to extract and provide the data. The participation of solely university affiliated teaching hospitals in large urban areas may have affected the findings related to unit type and nurse staffing. Previous research has indicated that there are significant differences in unit type and nurse staffing levels between different types of hospitals (Welton, Unurh & Halloran, 2006). In addition, many units were lost due to data management which may have contributed to a sample selection bias, especially since
the sample included in the data analysis differed from those excluded. The final sample providing data for model testing was comprised of a higher proportion of long term-complex continuing care units than those excluded from the study, which may have led to overrepresentation of long term care-complex continuing care units in the final sample. Nonetheless, the sample used in the analysis is representative of a variety of specialized and general medical-surgical inpatient units embedded within acute care hospitals.

The sample selected for this study may have limited the study’s findings related to the characteristics of the nurses employed by the participating units. Nurses employed in urban, university affiliated teaching hospitals may have had access to more educational resources such as academic education and continuing education, or clinical specialties than nurses who work for hospitals located in smaller, community or rural hospitals (Penz et al., 2007; Rondeau et al., 2009). Thus, nurses employed by the study units could have higher nursing human capital than nurses working on units located in other types of hospitals. Since nurses do not migrate considerably between cities and countries (CIHI, 2006b), it can be surmised that nurses’ knowledge and skills as well as the RN recruitment and retention rates may vary across cities or provinces in ways that could not be captured in this study.

The sources of the data used to measure some of the variables may have affected the congruence between the indicators and their related concepts or outcomes thus potentially limiting the results (Clarke & Donaldson, 2008). Although the conceptual and empirical indicators were derived from previous research or created from the empirical literature, they were limited by the data accessible within the participating hospitals; such as the data used to measure the unit’s patient falls and medication error rates. These measures relied on incident report data and despite it being the most feasible method for collecting the data on these variables, incident report data may produce underreporting and reporting biases (Blegen, 2006; Covell & Ritchie, 2009; Mark & Belyea, 2009).

Exploring the issues of underreporting and reporting bias, researchers (Covell & Ritchie, 2009) have recently confirmed that factors within the nurses’ work environment such as the unit’s leadership, nurses’ relationships with their colleagues, and the nurses’ perceived workload influence nurses’ incident reporting behaviors which often results in nurses
reporting fewer medication errors than actually occur. Specifically, it was found that when nurses believe the errors do not harm patients they will not report or they will use informal methods to report medication errors, such as consulting their colleagues. Thus nurses often decide to use incident reports to report only the medication errors they believe may harm patients. As such it could be surmised that factors with the nurses’ work environments may also influence nurses’ decisions to report other types of adverse events, such as patient falls; especially if they determine the patient was not physically harmed. Therefore for current study, it is possible that the medication error and patient fall rates used in the analysis were lower than what actually occurred; which may have affected the magnitude and/or direction of the parameter estimates used to measure the proposed relationships.

**Strengths of the Study**

This study had a number of strengths including the methods used to obtain and manage the data, a theory-guided research design and the use of SEM analysis. The methods used to obtain the data involved data collection forms that were carefully developed to ensure consistency of the data across all sites. Since researchers have identified complexities in using data not originally designed for research (Clarke & Donaldson, 2008), considerable effort was made to ensure precision in the data provided for each variable. This involved several strategies that were implemented prior, during and following data collection. Prior to data collection significant attention was given to the construction of the data collection forms. To ensure consistency in the data across sites the data collection forms included definitions and directions that outlined the specific data to be included for each variable. Additionally, to avoid variability in the data that could have occurred as the result of fluctuations in nursing services, the data were aggregated for a fiscal year. Lastly, to ensure clarity and meaning the data collection forms were pilot tested with representatives from related hospital departments and unit managers who were not involved in the study. During data collection efforts were made to make certain the respondents had a clear understanding of the type of data to be included for each variable. Any questions related to the content of the requested data were addressed by the investigator prior to data collection. Finally, prior to analysis the data were carefully cleaned and validated to ensure accuracy of the findings.
These strategies which were designed to address the technical issues associated with collecting primary data for the study variables facilitated a clear, consistent and accurate measurement across all sites.

An additional strength of the study is its uniqueness. Very few studies have tested nursing administrative theories. This study being the first to empirically test the nursing intellectual capital theory provides a novel paradigm for exploring the proposed theoretical links between nurses’ knowledge, skills and experience and outcomes. This theory-based study provided a clear rationalization for the inclusion of previously unrelated variables and meaning for their proposed interrelationships.

Additionally, the use of SEM provided an uncommon opportunity to simultaneously test the interrelationships among the variables. Also SEM accounted for measurement error during the statistical analysis (Schumacker & Lomax, 2004) which increased the accuracy of parameter estimates (Byrne, 2001).

**Implications of the Findings**

The implications of the study’s findings are discussed below. The discussion related to the implications for theory is followed by a discussion regarding the implications for nursing research, administrative practice, and nursing policy development.

**Implications for the theory.**

The nursing intellectual capital theory provides a conceptualization of nursing knowledge available in an organization (human and structural) and an explanation of the potential mechanisms responsible for the impact of nursing knowledge on patient and organizational outcomes. It also specifies some of the conditions under which the influence of knowledge may be observed. To date the availability of nursing theories to guide nursing administrative research is limited (Mark et al., 2004). In addition, there is little theoretical explanation of the relationship between nursing human capital (registered nurses’ experience and knowledge and skills acquired from CPD) and patient and organizational outcomes or the factors within the work environment that are related to nurses’ knowledge, skills and experience. Thus a
valid and comprehensive theory which conceptualizes nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) within an organization and its relationship to patient and organizational outcomes could be instrumental in guiding research in this area of nursing practice. The results of this study which tested selected propositions for the middle-range theory of nursing intellectual capital begins to address this gap in the literature by providing emerging evidence that nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) may influence the quality of patient care and the recruitment and retention of registered nurses. It also begins to illuminate possible empirical linkages between nurse staffing and patient outcomes by recognizing that the nurse staffing is related to nursing knowledge available on a unit, which in turn, is related to the quality of patient care. Although this study did not empirically validate all of the theory’s propositions, the theory does have the potential to contribute to the advancement of nursing practice by assisting researchers with uncovering the black box or processes of nursing care that remain difficult to elucidate and explain.

The nursing intellectual capital theory is a middle-range theory as it is composed of a limited number of concepts and propositions which can be measured and tested in different contexts (Fawcett, 1998). It introduces a new vocabulary to nursing by providing definitions for nursing knowledge within an organization (nursing human and structural capital). It also distinguishes nursing knowledge’s contribution to patients and organizations from that of other professions. Innovative in its conceptualization of the work environment as a major influencing factor on the development and use of the collective nursing staff human capital (knowledge and skills acquired from CPD), the nursing intellectual capital theory is explanatory in nature as it proposes meaningful interrelationships among characteristics within the work environment, such as nurse staffing levels, employers support for nurse CPD, nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD), and the quality of patient care and the recruitment and retention of RNs. Though the theory conceptualized the collective human capital of nurses providing direct care to hospitalized patients, it also shows promise for guiding studies designed to investigate the human capital of nurses that occupy other types of nursing roles such as advanced practice nurses. This type of investigation would require careful consideration of the desired
outcomes and factors that may be associated with the nurses’ use of their human capital. However, since the final model provides empirical support for several but not all of the theory’s propositions, future theoretical work is implicated to refine the theory’s propositions and the operationalization of concepts before the theory should be used to frame further research. In addition, refinement and testing of the middle-range theory of nursing intellectual capital in different geographical settings and types of hospitals are required prior to determining its suitability for guiding future research.

**Implications for nursing research.**

This study provides evidence of the nursing human capital or collective inpatient unit nursing staff’s knowledge (academic preparation: proportion of RNs with degrees), skills (proportion of RNs with specialty certification), and experience (RN professional experience and RN unit tenure) relationship to patient and organizational outcomes. There are several suggestions for future research.

Since this study had a sample selection bias, repeating the study with larger samples and/or randomly selected inpatient units that includes units from hospitals that are smaller in size, community based and or rurally located is warranted. This would determine the applicability of the theory to various types of hospitals and units. Future research which tests the nursing intellectual capital theory by using instruments designed to measure the intellectual capital within businesses other than health care (i.e. Fortune 500 companies), such as the Intellectual Capital Questionnaire by Bontis (2009), is also recommended. It would also be useful to compare and contrast the validity of the two types of data (i.e. responses to this questionnaire versus the indicators used in this study. Conducting studies that use the organization as the level of analysis or multiple sources of data (organizations, nurses and patients) and advanced statistical techniques (such as multilevel structural equation modeling or hierarchical linear modeling), which account for the nesting of patients and nurses within units and units within organizations, are also suggested.

Since three of the factor structures for the theory’s concepts did not hold, refining the operational definitions of the concept(s) is warranted. The empirical indicators of concepts should be revisited and alternative ones that more accurately measure the related concepts
should be explored. The relationship between the empirical indicators and their associated concepts should then be tested to determine their reliability and validity. This would also clarify if the nursing human capital concept is one construct as originally proposed, or two (nursing knowledge and nursing experience) as the results of the measurement model for this study suggests. Revising the empirical indicators for the nursing human capital concept to reflect nurses’ clinical expertise (Capuano et al., 2005), or restrict the hours of CE attended by RN to reflect hours of CE pertaining to the patient outcomes under study (e.g., hours of CE attended by RN regarding the prevention of medication errors, or patient falls) could be considered. Thought may be given to refining the empirical indicators for the nursing structural capital concept to reflect the nurses’ use of technology for diagnostic purposes (e.g. blood glucometers, telemetry) or portable computerized devices (e.g. laptops, personal digital assistants) for acquiring evidence-based information when delivering care (Doran & Mylopoulos, 2008).

Further testing of the nurse staffing concept by replicating the factor analysis with different samples of units is necessary to determine if the indicators continue to accurately capture the concept. If it is found that the nurse staffing concept is a valid and reliable measure of a unit’s nurse staffing, the construct may be used in future studies to measure the amount of nurse staffing available and used in delivering care (Mark et al., 2004). Yet, since the empirical indicators used to measure the nurse staffing concept reflect primarily RN care (i.e. skill mix: proportion of RN hours to the total nursing earned hours skill mix, and RN-to-patient ratio) some consideration may be given to the use of empirical indicators that reflect the inclusion of LPNs (e.g. skill mix: proportion of RNs and LPN or licensed nursing staff to the total nursing earned hours, and RN and LPN or nurse-to-patient-ratio) to determine if the nurse staffing concept remains a valid factorial structure with the inclusion of all professional (licensed) nursing staff. Using reliable measures of nurse staffing has the potential for contributing to a consistent body of empirical evidence for nurse staffing thus addressing the inconsistent results reported in the literature (Jiang, Stocks & Wong, 2006; Clarke & Donaldson, 2008).
This study found the proportion of RNs with degrees partially mediated the relationship between nurse staffing and hospital-acquired infection; however the other nursing knowledge indicators, proportion of RNs with specialty certification, and RN professional and unit tenure did not mediate the relationships between nurse staffing and any of the patient or organizational outcomes, as hypothesized. Future research using different samples of units and large sample sizes are needed to replicate this proposed relationship.

Testing the theory by modifying the existing outcomes or using different patient and organizational outcomes is also suggested. This could involve adapting the patient outcomes used in the current study to reflect adverse events that cause patient harm such as patient falls with injury, medication errors requiring intervention, or surgical wound infections and revising the organizational outcomes to include other cost related outcomes such as the cost of adverse events (Pappas, 2008). Researchers might also test the theory by using nursing sensitive outcomes that are positive in nature such as those that measure improvement in patient functional status or symptom management (Doran et al., 2003).

Patient characteristics were not included in the model testing as the middle-range theory of nursing intellectual capital does not stipulate how patient characteristics may influence nurses’ knowledge, skills and experience, and in turn patient and organizational outcomes. However since previous research has accounted for the influence of patient characteristics on unit-level nurse staffing, future testing of the theory while controlling for patient acuity (nursing intensity weights) or patient risk for experiencing the adverse event (risk adjustment scores) may be considered (Clarke & Donaldson, 2008). Conducting such research may help explain the relationships found in this study which are opposite to what was hypothesized; specifically the relationships between high levels of nurse staffing and high rates hospital-acquired infections, and medication errors.

Additionally, the middle-range theory of nursing intellectual capital does not specify nurse-level outcomes. Since previous research has found significant relationships between higher levels of nurse staffing and higher nurse burnout and higher nurse job satisfaction (Aiken et al, 2002) and the theory could be extended to include nurse-level outcomes such as nurses’ job satisfaction, or intent to stay. Since nurses work in multidisciplinary environments,
thought may be given to investigating if nurses’ relationships with other health care providers such as physicians, physical therapists, pharmacists, influence gain of knowledge, skills and experience, development and use of relevant clinical guidelines and in turn, patient and organizational outcomes.

**Implications for administrative practice.**

The findings from this study suggest that in order to ensure good quality and cost-effective patient care, unit managers may consider retaining nursing staff with high human capital; specifically a RN staff that is highly educated (academic preparation), specialty certified and experienced. Administrators can accomplish these objectives in several ways. First to increase the academic preparation of their staff, unit managers can adjust their hiring practices to include a greater proportion of baccalaureate prepared RNs, reimburse RNs for the expenses associated with advancing their academic education and make efforts to retain RNs with degrees. Although it remains uncertain what proportion of baccalaureate-prepared RN on a unit is ideal for ensuring quality of patient care, there is emerging evidence that indicates once the proportion of RNs with degrees exceeds 54% it may no longer be associated with further lowering numbers of severe medication errors (Chang & Mark, 2009). Therefore until there is further evidence, when possible unit managers can strive to have an RN staff where the majority of the RNs are degree-prepared.

Previous evidence and the findings from this study indicate that units that employ a high number of RNs that are specialty certified may provide safer patient care (Bulla, 2002; Newhouse, Johantgen & Pronovost, 2005; Kendall-Gallagher & Blegen, 2009). Thus unit managers may consider assisting RNs with obtaining specialty certification associated with the type of patients cared for on the unit by offering to subsidize the expenses associated with specialty certification such as the examination and recertification fees and providing paid time off to prepare for and write the exam.

Retaining nurses, thus reducing turnover, is essential for controlling human resource costs (O’Brien-Pallas et al., 2006). This is particularly important for specialty areas where it has been estimated that replacing an experienced specialty nurse can exceed the nurse’s salary for one year (Bland-Jones, 2008). Although this study did not find statistically significant
differences between unit type and the proportion of RN hours used for orientation, informing unit managers of the importance of retaining experienced nurses and thus their human capital and how it can lead to good quality patient care and potentially lower costs associated with the recruitment and retention of RNs is recommended. Managers may find facilitating nurses’ participation in ongoing learning activities enhances their human capital (knowledge and skills), which may lead to the retention of nursing human capital (knowledge, skills and experience of nurses), and in turn better quality patient care.

This study found that units with high levels of nurse staffing had high hospital-acquired infection and medication errors rates and lower patient fall rates. For units that have high acuity patients such as intensive care units, unit managers can reinforce the need for nurses to take the necessary precautions to prevent hospital-acquired infections and medication errors. Unit managers may also want to pay attention to the combination of the mobility and acuity levels of their patients and provide high levels of nurse staffing when they determine their patients require increased supervision to avoid falling. Since nurse staffing for this study was measured as the combination of HPPD, skill-mix and RN-to-patient ratio, when unit managers make patient assignments they may consider not only the supply of nurses available on a unit to care for patients but also the mix of nurses required to provide safe patient care. Another strategy that managers of units with high acuity patients can use to improve the quality of patient care is to increase the unit’s proportion of RNs with degrees. This recommendation arises from the findings that units with high levels of nurse staffing had a high proportion of RNs with degrees and low rates of hospital-acquired infections.

The education of nurses within hospitals through the provision of CE activities such as in-services, workshops and conferences should be guided by theories not only related to how learning occurs but also those which explain the conditions under which the uptake and use of the knowledge in practice is optimal (Committee on Planning a Continuing Health Professional Education Institute, 2010). In order, to ensure the CE activity has the greatest impact on patient care and costs, it is recommended that the assessment, planning and evaluation of the CE activities and its impact occur at the group or unit level. Unit managers are encouraged to consider conditions of the work environment (nurse staffing levels) and
their potential influence on the nurses’ ability to attend educational activities. This study found that amount and type of internal and external learning activities in which nurses participated were not readily available to the unit managers. Therefore keeping records of the types and hours of internal and external CPD activities attended per RN is suggested. Since nurses are the most knowledgeable about the type and amount of CPD in which they take part, the development of a nursing human capital database where nurses can independently update their human capital (knowledge, skills and experience) profile would give unit managers a clearer idea of the amount of nursing human capital available on their unit. Managers may be able to use this information for patient assignments, mentoring and performance appraisals.

**Implications for nursing policy development.**

This study provides some evidence that nurses’ knowledge, specifically the proportion of RNs with degrees and specialty certification, is associated with the quality of patient care of an inpatient unit. These findings are consistent with existing research indicating that when inpatient care units employ a majority of RNs with baccalaureate preparation patients may receive high quality care. Therefore governments may consider enacting policies that promote university education for registered nurses. This can be accomplished by assisting with the costs associated with university education or by providing bursaries and time off or unpaid leave of absences for RNs to return to school. Since this study found that unit RNs who received funding to attend CE attended more CE, professional organizations are also encouraged to consider continuing their financial support for nurses to further their academic education, obtain specialty certification and attend workshops and conferences (RNAO, 2010). However the relationship of mandatory CE to patient outcomes is not yet fully substantiated (Committee on Planning a Continuing Health Professional Education Institute, 2010); therefore licensing bodies’ requirement of nurses to participate in a minimum number of CE hours in order to demonstrate continued competence remains in question.

Since retaining experienced RNs, especially over the long term, is related to lower orientation costs, policies designed to encourage the retention of RNs are needed. Such policies ought to include the provision of permanent full-time positions for new graduate
nurses which will provide them with the work experience required to strengthen their human capital (knowledge and skills) and the opportunity to benefit from the mentoring of more experienced nurses (Torgerson, 2007).

As a method for ensuring safe patient care within hospital some governments, such as the State of California, have enacted legislation mandating minimum RN-to-patient ratios. Since previous research did not find that mandated nurse staffing ratios in California led to improvement in nursing sensitive patient outcomes (Bolton et al., 2007) and this study found that nurse staffing is the combination of the amount of nurse staffing available per hospitalized patient, mandating specific nurse staffing ratios alone may not be sufficient for improving care. Therefore legislators may consider mandating minimum staffing levels that include other staffing variables within hospitals such as skill-mix and HPPD.

The extent of nursing human capital available within Canada remains unknown. Creating provincial or national databases that reflect the knowledge, skills and experience of Canadian nurses, as well as its distribution throughout the country would provide valuable information to governments which would assist them with planning future investments for nursing human resources (Tomblin Murphy, 2005).

**Summary and Conclusions**

The purpose of this study was to test selected propositions from the middle-range theory of nursing intellectual capital. The middle-range theory of nursing intellectual capital proposes that nurse staffing and employer support for nurse CPD are associated with nursing human capital; nursing human capital is directly associated with quality of patient care and RN recruitment and retention outcomes, and nursing structural capital is directly associated with quality of patient care. Overall, the final model revealed that the unit’s nurse staffing (operationalized as HPPD, skill-mix and RN-to-patient ratio) is directly associated with the quality of patient care (patient fall, medication error and hospital-acquired infection rates) and the proportion of RNs with degrees, which in turn is indirectly associated with the quality of patient care on the unit (hospital-acquired infection rate). It was also found that the proportion of RNs with degrees and the proportion of RNs with specialty certification are directly associated with the quality of patient care (hospital-acquired infections) on a unit.
The proportion of RNs with specialty certification, RN unit tenure and RN professional experience are directly related to the recruitment and retention of registered nurses, operationalized as the proportion of RN earned hours used for RN orientation, RN recruitment rate and RN vacancy rate. These findings support the theory proposition that nursing human capital (registered nurses’ experience, and knowledge and skills acquired from CPD) are associated with the quality of patient care and the recruitment and retention of nurses. This study provides preliminary empirical evidence supporting the theory; however replicating the research with larger samples is necessary in order to confirm the current study’s findings.
## Appendix A. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
<th>Concept</th>
<th>Domain</th>
<th>Attribute or Variable</th>
<th>Operational Definition</th>
<th>Empirical Definition</th>
<th>Empirical Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Human Capital</td>
<td>Nursing Knowledge and Skills</td>
<td>Academic preparation</td>
<td>Highest level of degree obtained</td>
<td>Proportion of RNs with degrees</td>
<td># of RNs with BSN or higher Total # of RNs</td>
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</tr>
<tr>
<td>Nursing Human Capital</td>
<td>Nursing Knowledge and Skills</td>
<td>Continuing Professional Development</td>
<td>Learning that takes place after the nurse enters profession. CPD includes continuing</td>
<td>The mean number of hours of CE attended by unit RNs</td>
<td>Total number of hours of CE attended by unit RNs</td>
</tr>
<tr>
<td></td>
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<td>education programs, university courses, short programs</td>
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<tr>
<td>Nursing Human Capital</td>
<td>Nursing Knowledge And Skills</td>
<td>Specialty Certification</td>
<td>Specialty Certification is formal recognition by an organized professional body of the</td>
<td>Proportion of RNs with certification</td>
<td># of RNs with Specialty Certification Total # of RNs</td>
</tr>
<tr>
<td></td>
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<td>specialized knowledge, skills, and experience, which confirms that a RNs has met</td>
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<td>predetermined standards of competency as, identified by a nursing professional organization</td>
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<td>(ABNS, 2006; CNA, 2007).</td>
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</tbody>
</table>
## Appendix A continued. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
<th>Concept</th>
<th>Domain</th>
<th>Attribute or Variable</th>
<th>Operational Definition</th>
<th>Empirical Definition</th>
<th>Empirical Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Human Capital</td>
<td>Nursing Experience</td>
<td>Years of Professional Experience</td>
<td>The experience the unit RNs received since licensure.</td>
<td>The unit RN professional experience rate</td>
<td>Total number of years of RN professional experience</td>
</tr>
<tr>
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<td></td>
<td>Total # of RNs</td>
</tr>
<tr>
<td></td>
<td>Nursing Experience</td>
<td>Years in the Clinical Specialty</td>
<td>The experience the unit RNs received from working in the clinical specialty of the unit.</td>
<td>The unit RN clinical specialty experience rate</td>
<td>Total number of years in RN clinical specialty experience</td>
</tr>
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<td></td>
<td>Total # of RNs</td>
</tr>
<tr>
<td></td>
<td>Nursing Experience</td>
<td>RN unit tenure</td>
<td>The experience the unit RNs received from working on the unit.</td>
<td>The unit RN unit tenure rate</td>
<td>Total number of years of RN unit tenure (seniority)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Total # of RNs</td>
</tr>
<tr>
<td>Nursing Structural Capital</td>
<td>Nursing Knowledge converted to</td>
<td>Care maps, practice guidelines or protocols</td>
<td>Availability of practice guidelines, protocols, or care maps.</td>
<td>Availability of practice guidelines protocols, or care maps for the prevention of:</td>
<td>Availability of practice guidelines, protocols or care maps for the prevention of:</td>
</tr>
<tr>
<td></td>
<td>information</td>
<td></td>
<td></td>
<td>1) patient falls, 2) medication errors and 3) hospital-acquired infections.</td>
<td>1) patient falls, 2) medication errors and 3) hospital-acquired infections</td>
</tr>
</tbody>
</table>
### Appendix A continued. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
<th>Concept</th>
<th>Domain</th>
<th>Attribute or Variable</th>
<th>Operational Definition</th>
<th>Empirical Definition</th>
<th>Empirical Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employer Support for nurse CPD</td>
<td>Human &amp; Financial Resources</td>
<td>Replacement</td>
<td>Replacement of RN with a RN of comparable knowledge, skills and experience while the nurse is away unit to attend CPD</td>
<td>Provision of replacement staff for RNs while they are away to learn</td>
<td>Percent of the time RNs replaced on unit when they are away from the unit to learn</td>
</tr>
<tr>
<td>Employer Support of nurse CPD</td>
<td>Financial Resources</td>
<td>Unpaid time off to attend CPD</td>
<td>RN is given unpaid time off to attend CPD</td>
<td>Total number of unpaid hours or absences allocated for RNs to learn including unpaid study leaves.</td>
<td>Total number of hours of unpaid time off or absences allocated to RNs for time off to learn Total inpatient nursing earned hours</td>
</tr>
<tr>
<td>Employer Support of nurse CPD</td>
<td>Financial Resources</td>
<td>Paid time off to attend CPD</td>
<td>RN is given paid time off to attend a CPD activity</td>
<td>Proportion of nursing staff hours utilized for RNs to attend CPD per fiscal year.</td>
<td>Number of hours utilized for RNs to attend CPD Total inpatient nursing earned hours</td>
</tr>
<tr>
<td>Employer support for nurse CPD</td>
<td>Human Resources</td>
<td>Clinical Nurse Educator/Consultant</td>
<td>Availability of Clinical Educator/Consultants to provide decision-making support to unit RNs</td>
<td>Ratio of clinical educators to RNs.</td>
<td>Number of FTE nurse educators or nurse consultants Number of RN FTE</td>
</tr>
<tr>
<td>Concept</td>
<td>Domain</td>
<td>Attribute or Variable</td>
<td>Operational Definition</td>
<td>Empirical Definition</td>
<td>Empirical Indicator</td>
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</tr>
<tr>
<td>Employer Support of nurse CPD</td>
<td>Financial Resources</td>
<td>Financial assistance to attend CPD</td>
<td>RN is provided with funding to attend CPD activities</td>
<td>Mean number of RNs who received financial assistance by hospital to attend CPD activities in last fiscal year.</td>
<td>Number of RNs that received financial assistance from hospital to attend CPD activities Total number of RNs</td>
</tr>
<tr>
<td>Nurse Staffing</td>
<td>Nursing care hours per patient</td>
<td>Hours per patient per day (HPPD)</td>
<td>The number of nursing hours utilized for direct patient care per patient day. Direct patient care hours exclude hours used for benefits, orientation or education and include the tasks that nurses do on behalf of the patient in an effort to assist with meeting basic human needs (O'Brien-Pallas et al., 2005a).</td>
<td>The number of unit inpatient care hours used per patient per day.</td>
<td>Total nursing care hours patient per day</td>
</tr>
<tr>
<td>Nurse Staffing</td>
<td>Proportion of RNs to other nursing staff</td>
<td>Skill-mix</td>
<td>The proportion of RN hours to nursing staff hours.</td>
<td>The proportion of unit hours allocated for RNs.</td>
<td>Inpatient RN earned hours RN + RPN + non-professional earned hours</td>
</tr>
</tbody>
</table>
### Appendix A continued. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
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<th>Operational Definition</th>
<th>Empirical Definition</th>
<th>Empirical Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Staffing</td>
<td>Number of patients per RN</td>
<td>RN-patient ratio</td>
<td>The number of patients cared for by one registered nurse.</td>
<td>The mean number of patient cared for by one RN during each shift weekdays and weekends</td>
<td>RN to patient ratio for days, evenings and night shifts for weekdays and weekends</td>
</tr>
<tr>
<td>Quality of Patient Care</td>
<td>Patient safety or adverse event</td>
<td>Patient Falls</td>
<td>An unintended event resulting in a person coming to rest on the ground/floor or other lower level (witnessed), or is reported to have landed on the floor (unwitnessed) not due to any intentional movement or extrinsic force such as stroke, fainting, seizure (RNAO, 2002).</td>
<td>Unit Rate of Patient Falls</td>
<td>Number of patient falls 1,000 patient days</td>
</tr>
<tr>
<td>Quality of Patient Care</td>
<td>Patient safety or adverse event</td>
<td>Hospital-acquired infections</td>
<td>Hospital-acquired infection occurred when there was no documentation of the existence of an infection within the first 24 hours following the patient’s admission.</td>
<td>Unit Rate of Hospital-acquired Infections</td>
<td>Number of C-Difficile, MRSA and VRE infections 1,000 patient days</td>
</tr>
</tbody>
</table>
## Appendix A. continued. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
<th>Concept</th>
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<th>Attribute or Variable</th>
<th>Operational Definition</th>
<th>Empirical Definition</th>
<th>Empirical Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Patient Care</td>
<td>Patient safety or adverse event</td>
<td>Medication Errors</td>
<td>Medication error is a preventable event that results in the incorrect administration of a drug, either in dose, timing, patient identification, or drug identification (Doran, 2001).</td>
<td>Unit Rate of Medication Errors</td>
<td>Number of medication errors 1,000 patient days</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Recruitment and Retention of Nurses</td>
<td>Orientation Costs</td>
<td>Orientation Hours</td>
<td>The proportion of unit hours used to orient newly hired RNs to be oriented to the hospital and unit.</td>
<td>The proportion of unit hours used for RN orientation</td>
<td>Number of earned orientation hours used for newly hired RNs RN inpatient earned hours</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Recruitment and Retention of Nurses</td>
<td>Nurse Vacancy</td>
<td>Unit RN Vacancy Rate</td>
<td>Proportion of unfilled RN FTE positions to filled positions</td>
<td>Unit Rate for RN Vacancy</td>
<td>Number of vacant RN budgeted FTE positions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number of RN budgeted FTE positions</td>
</tr>
</tbody>
</table>
## Appendix A continued. Study Variables, Operational Definitions, Empirical Indicators and Definitions

<table>
<thead>
<tr>
<th>Concept</th>
<th>Domain</th>
<th>Attribute or Variable</th>
<th>Operational Definition</th>
<th>Indicator</th>
<th>Indicator Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment and Retention of Nurses</td>
<td>Nurse Turnover</td>
<td>Unit RN Turnover Rate</td>
<td>Proportion of RNs FTEs that resigned from the unit</td>
<td>Unit Rate for RN Turnover</td>
<td>Number of voluntary RN FTE separations Total number of RN budgeted FTE positions</td>
</tr>
<tr>
<td></td>
<td>Recruitment</td>
<td>Unit RN Recruitment Rate</td>
<td>Proportion of RN FTE newly hired for the unit</td>
<td>Unit Rate for RN Recruitment</td>
<td>Number of newly hired RN FTEs Total number of RN budgeted FTE positions</td>
</tr>
</tbody>
</table>

Some of the operational definitions and indicators if not otherwise indicated have been obtained or adapted from Doran, 2001; Edvinsson and Malone (1997), Lankshear, Sheldon and Maynard (2005), McGillis Hall (2003), McGillis Hall et al. (2001; 2004) and Stewart (1997; 2001).
Appendix B. Nursing Intellectual Capital Unit Manager Survey

Nursing Intellectual Capital  
Unit Manager Survey

The purpose of this survey is to examine the support that registered nurses (RNs) receive to develop their knowledge and skills. The survey will take approximately 30-45 minutes to complete. All responses will be kept strictly confidential. Thank you in advance for your time and cooperation.

Part I: Please provide the information that best reflects the extent to which registered nurses on your unit were supported to develop their knowledge and skills during the last fiscal year.

1. In the last fiscal year, how many full-time equivalent (FTEs) nursing positions such as nurse educators or consultants were available to the RNs on your unit to support the RN’s clinical decision-making or for providing the RNs with education?

   Directions: If the position is shared between units or the individual is responsible for other activities then please indicate the portion of the FTE that is available only to the RNs on your unit (i.e. .5 FTE or one half of a FTE) for education or clinical decision-making support.

   ________number of nurse educator or consultant FTE positions

2. During the last fiscal year, what percent of the time were the RNs on your unit replaced when they were away from the unit engaging in learning activities?

   Directions: Include the percent of time RNs were replaced when they were away from the unit to learn. Do not include the replacement of nurses on orientation such as newly hired RNs or nurses with temporary registered nurse license (RN Temp).

   ________ % of the time
3. By the end of the last fiscal year, how many RNs on your unit were certified by a specialty organization?

**Directions:** Include the **total** number of RNs on your unit that obtained specialty certification from a professional association, such as the Canadian Nurses Association by the end of the last fiscal period.

<table>
<thead>
<tr>
<th>Number of RNs</th>
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</table>

4. For the last fiscal year, how many RNs on your unit received financial support from the hospital to attend continuing professional development activities?

**Directions:** Include the total number of registered nurses who received financial support from the organization for each of the following continuing professional development activities in the last fiscal year.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of RNs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Bursaries or scholarships</td>
<td>_______</td>
</tr>
<tr>
<td>b. Special certification fees</td>
<td>_______</td>
</tr>
<tr>
<td>c. Tuition reimbursement for college or university courses</td>
<td>_______</td>
</tr>
<tr>
<td>d. Conference fees</td>
<td>_______</td>
</tr>
<tr>
<td>e. Short programs</td>
<td>_______</td>
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<tr>
<td>f. Other, specify</td>
<td>_______</td>
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<td></td>
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<tr>
<td>Total Number of RNs</td>
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</tbody>
</table>
5. During the last fiscal year, how many hours of continuing professional development did the RNs on your unit attend?

**Directions:** Include the total number of hours for each continuing professional development activity attended by the RNs on your unit in the last fiscal year.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Conferences, Workshops</td>
<td></td>
</tr>
<tr>
<td>b. Certification</td>
<td></td>
</tr>
<tr>
<td>c. College or university courses</td>
<td></td>
</tr>
<tr>
<td>d. In-services</td>
<td></td>
</tr>
<tr>
<td>e. Short programs</td>
<td></td>
</tr>
<tr>
<td>f. Other, specify</td>
<td></td>
</tr>
</tbody>
</table>

**Total Number of Hours**

6. In the last fiscal year, what was the total number of unpaid hours allocated for RNs to learn?

**Directions:** Please include the total number of hours of unpaid time off or absences allocated to RNs to attend continuing professional development activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Unpaid Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Conferences, Workshops</td>
<td></td>
</tr>
<tr>
<td>b. Certification</td>
<td></td>
</tr>
<tr>
<td>c. College or university courses</td>
<td></td>
</tr>
<tr>
<td>d. In-services</td>
<td></td>
</tr>
<tr>
<td>e. Short programs</td>
<td></td>
</tr>
<tr>
<td>f. Unpaid study leaves of absences</td>
<td></td>
</tr>
</tbody>
</table>

**Total Number of Unpaid Hours**
7. During the last fiscal year were care maps, practice guidelines, or protocols for the management or prevention the following adverse events available on your unit?

<table>
<thead>
<tr>
<th>Event</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Patient falls</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b. Medication errors</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c. Hospital-acquired infections</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

8. In the last fiscal year, what was the RN-to-Patient Ratio on your unit?

**Directions:** Please indicate the RN-to-Patient Ratio for each of the following:

<table>
<thead>
<tr>
<th>Shift</th>
<th>RN-to-Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Day shift Monday-Friday</td>
<td>1 RN to _____ Patients</td>
</tr>
<tr>
<td>b. Day shift Saturday-Sunday</td>
<td>1 RN to _____ Patients</td>
</tr>
<tr>
<td>c. Evening shift Monday-Friday</td>
<td>1 RN to _____ Patients</td>
</tr>
<tr>
<td>d. Evening shift Saturday-Sunday</td>
<td>1 RN to _____ Patients</td>
</tr>
<tr>
<td>e. Night shift Monday-Friday</td>
<td>1 RN to _____ Patients</td>
</tr>
<tr>
<td>f. Night shift Saturday-Sunday</td>
<td>1 RN to _____ Patients</td>
</tr>
</tbody>
</table>
9. During the last fiscal year, what is the total number of years of unit seniority of RNs employed by unit?

**Directions:** add together the number of years of unit seniority for each RN employed by the unit for a total number of years of RN unit seniority. (Example: 3 years of unit seniority; 5.5 years of unit seniority; 6 months of unit seniority (0.5 years of unit seniority) = 9 years of unit seniority of all unit RNs).

| ______ total number of years of unit seniority |

10. By the end of the last fiscal year, what was the number of years of experience the RNs on your unit had in the clinical specialty of your unit?

**Directions:** Include the total number of years of clinical specialty experience for each RN employed on your unit in last fiscal year for a total number of years. (Add each nurse’s years of clinical specialty experience for a total number of years of clinical experience for all the RNs on your unit).

| ______ Total number of years of clinical specialty experience |

| ______ I do not have this information for all the RNs on my unit |
Part 2: The following questions are designed to describe the characteristics of your unit. The information collected will be used to assist with data analysis.

1. What type of clinical specialty is your unit? Check the one that best represents your unit.

   a. Adult Medical
   b. Adult Surgical
   c. Adult Medical-Surgical (Combined)
   d. Adult Critical-Care
   e. Obstetrics
   f. Pediatrics
   g. Adult Psychiatry
   h. Acute Geriatrics or Complex Continuing Care
   i. Adult Long term Care
   j. Other, please specify: _______________

2. For the last fiscal year, what was the total number of patient beds staffed and in operation on your unit?

   _______ Total number of patient beds

3. For the last fiscal year, what was the average patient length of stay on your unit?

   _______ Average patient length of stay on unit
Appendix C. Nursing Intellectual Capital Study Financial/Human Resource Unit Measures Data Collection Form

NURSING INTELLECTUAL CAPITAL STUDY
FINANCIAL/HUMAN RESOURCE UNIT MEASURES
DATA COLLECTION FORMS

INVESTIGATORS:
Christine L. Covell RN, MSN, PhD Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8
christine.covell@utoronto.ca
Telephone: (416) 978-1578
And
Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing University of Toronto and
Canadian Research Chair-Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
ssidani@ryerson.ca
Telephone: (416) 979-5000 extension 2572

UNIT______
**Nursing Intellectual Capital Study**  
Financial/ Human Resources Unit Measures Form

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total inpatient <strong>earned hours for all staff</strong></td>
<td>Directions: Include total inpatient hours used for all staff including hours for benefits and purchased hours for all float staff, agency staff or sitters for last fiscal year. Exclude hours for managers.</td>
<td></td>
</tr>
<tr>
<td>2. Total inpatient <strong>RN earned hours</strong></td>
<td>Directions: Include total inpatient hours used for RN staff, including hours for benefits and purchased RN hours for float RNs and agency RNs for last fiscal year. Exclude hours for managers.</td>
<td></td>
</tr>
<tr>
<td>3. Total inpatient <strong>RPN earned hours</strong></td>
<td>Directions: Include total inpatient RPN hours including hours for benefits and purchased hours for float or agency RPNS for last fiscal year. Exclude hours for managers.</td>
<td></td>
</tr>
<tr>
<td>4. Total inpatient <strong>nonprofessional earned hours</strong></td>
<td>Directions: Include total inpatient hours used for nonprofessional staff including hours for benefits and purchased hours for float nonprofessional staff and agency staff (e.g. sitters or unregulated workers) for last fiscal year. Exclude hours for managers.</td>
<td></td>
</tr>
</tbody>
</table>
**Nursing Intellectual Capital Study**  
**Financial/Human Resources Unit Measures Form continued.**

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. <strong>Total inpatient worked hours</strong></td>
<td>Directions: Include total inpatient hours used for all staff including purchased hours for all float staff, agency staff and sitters <em>excluding hours for benefits</em> (nonworked hours) for last fiscal year. Exclude hours for managers.</td>
<td></td>
</tr>
</tbody>
</table>
| 6. **Total number of RN budgeted positions** | Total number of **RN (FTEs) positions** budgeted per unit for last fiscal year.  
**Directions:** Include all budgeted RN positions (Full and part time) for a total number of RN FTEs (i.e. 35.8 FTEs). |                                |
| 7. **Total number of RNs employed by unit**  | Total **number of RNs** employed by unit in last fiscal year.  
**Directions:** Include all RNs that are employed by the unit for a total number of RNs. |                                |
### Nursing Intellectual Capital Study
Financial/Human Resources Unit Measures Form continued.

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
</table>
| **Paid time off to learn**                    | Total number of paid hours used for RNs to learn in last fiscal year.  
  Directions: Include the total number of paid hours allocated for RNs to attend CPD including paid study leaves to attend courses, conferences, certification, short programs or in-services. |                               |
| 9. Number of **unit earned hours** used for RN orientation | Number of unit earned hours allocated for the orientation of new RNs for last fiscal year  
  Directions: Include the worked hours plus hours for benefits, directly associated with the salary of newly hired (RNs) only for the period they are on orientation (corporate and unit). |                               |
**Nursing Intellectual Capital Study**  
Financial/ Human Resources Unit Measures Form continued.

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
</table>
| 10. Total number of unit RNs with BSN or higher | Total number of unit RNs with a BSN degree or higher employed by unit in the last fiscal year. 

  **Directions:** Include nurses with temporary registered nurse license (RN Temp).                                                                                                                                                                                                                                                                                           |                                |
| 11. Number of years of professional experience of unit RNs | The years of professional experience of RNs (years of experience as a RN) employed by unit within the last fiscal year. *Professional experience is defined as years of experience as a registered nurse.*

  **Directions:** add the number of years of professional experience of each RN hired by unit together for a total number of years of professional experience of unit RNs (Example: 3 year of experience as a RN, 5.5 years of experience as an RN, 6 months (0.5 years) of experience as an RN = 9 years of RN professional experience of unit RNs). |                                |
### Nursing Intellectual Capital Study
Financial/ Human Resources Unit Measures Form continued.

**Directions**: Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Number of <strong>vacant RN positions</strong></td>
<td>Total number of <strong>permanent</strong> RN positions unfilled for the last fiscal year. <strong>Directions</strong>: Do not include vacancies for maternity, sick or study leaves of absences. Include only permanent RN positions that are vacant and have not been filled as of the end of the last fiscal year.</td>
<td></td>
</tr>
<tr>
<td>13. Total number of <strong>voluntary RN separations</strong></td>
<td>Number of RNs that voluntarily terminated their employment with the unit (by transferring to another unit or resigning from the hospital) in the last fiscal year. <strong>Directions</strong>: Include the total number of voluntary terminations from the unit within the last fiscal year. Include all RNs and nurses with temporary registered nurse license (RN Temp) working for unit that transferred or resigned from the hospital.</td>
<td></td>
</tr>
</tbody>
</table>
**Nursing Intellectual Capital Study**  
Financial/ Human Resources Unit Measures Form continued.

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year (April 1, 2007-March 31, 2008).

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Definition/Directions</th>
<th>Total per the last fiscal year</th>
</tr>
</thead>
</table>
| 14. Total number of **RNs hired per unit** per fiscal year | Total number of **RNs hired by unit** in the last fiscal year.  
**Directions:** Include all RNs and nurses with temporary registered nurse license (RN Temp) working for unit in the last fiscal year. |                                |
| 15. **Mean age of the RNs** on the unit. | Mean age of RNs on the unit for the last fiscal year.  
**Directions:** Add the ages of the all RNs employed on the unit for a total. Include the ages of RNs and nurses with temporary registered nurse license (RN Temp) working for unit in the last fiscal year. |                                |
| 16. Total number of **patient days** | **Directions:** Include the total number of days for all patients who were admitted to the **unit in the last fiscal year** for an episode of care and who separated from the unit after a specified period of time. |                                |
Appendix D. Nursing Intellectual Capital Study Risk Management Unit Measures Data Collection Forms

NURSING INTELLECTUAL CAPITAL STUDY
RISK MANAGEMENT UNIT MEASURES
DATA COLLECTION FORMS

INVESTIGATORS:

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing University of Toronto and
Canadian Research Chair-Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
ssidani@ryerson.ca
Telephone: (416) 979-5000 extension 2572

and

Christine L. Covell RN, MSN, PhD Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8
christine.covell@utoronto.ca
Telephone: (416) 978-1578

UNIT_______
### Nursing Intellectual Capital

**Risk Management Unit Measures Data Collection Form**

**Directions:** Please provide the following information for the inpatient unit (identified on the cover sheet) for the last fiscal year.

<table>
<thead>
<tr>
<th>Adverse events</th>
<th>Definition</th>
<th>Number Per Unit Per Last Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of patient falls</td>
<td><strong>Directions:</strong> Include the number of incidents that report a patient fall with or without injury that occurred on the unit within the last fiscal year (March 31, 2008).</td>
<td></td>
</tr>
<tr>
<td>2. Number of medication administration errors</td>
<td><strong>Directions:</strong> Include the number of incidents that report a medication error with or without injury that occurred on the unit with the last fiscal year.</td>
<td></td>
</tr>
<tr>
<td>3. Number of hospital-acquired infections</td>
<td><strong>Directions:</strong> Include the number of VRE, C-Difficile, and MRSA infections that have been reported to occur when there was no documentation of the existence of a VRE, C-Difficile or MRSA infection within the first 24 hours following the patient’s admission to the unit/hospital within the last fiscal year (March 31, 2008). Please provide # of VRE________, C-Difficile_______ and MRSA_______.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E. Nursing Intellectual Capital Study Thank you/Reminder Email for Unit Managers

University of Toronto

Email Header

Date

Dear Unit Manager,

Last week a survey was given to you that requested information about the support registered nurses from your unit receive for developing their knowledge and skills and about your unit.

If you have already completed and returned the survey, please accept our sincere thanks. If not, please do so at your earliest convenience. We are especially grateful for your help because it is only by asking unit managers that we will be able to understand how much and what kind of support registered nurses receive for developing their knowledge and skills, and the effect it has on outcomes.

If you require a copy of the survey, please call Christine Covell at (416) 978-1578 or email her at christine.covell@utoronto.ca.

Sincerely,

Christine L. Covell RN, MSN, PhD Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto and Canadian Research Chair
Ryerson University
350 Victoria Street Toronto
Ontario, M5B 2K3
Appendix F. Nursing Intellectual Capital Study Letter Accompanying Replacement Unit Manager Survey

Lawrence Bloomberg Faculty of Nursing

University of Toronto Letterhead

Date

Dear Unit Manager’s Name

About three weeks ago a survey was given to you that asked about the support registered nurses from your unit receive for developing their knowledge and skills.

If you have already completed and returned the survey, please accept our sincere thanks. If you did not complete the survey, please find attached a copy of the survey for you to complete at your earliest convenience.

Your responses to this survey are very much appreciated and will contribute to our understanding of the influence of nurses’ knowledge, skills, and experience to quality care and nurse recruitment and retention.

Please note that a survey identification number is printed on the top right of the survey to maintain confidentiality. The name of your unit will not be identified in any report, and can never be connected to the results in any way. Protecting confidentiality is very important to us.

If for any reason you prefer not to complete the survey, please return a blank survey in the enclosed stamped envelope. If you have any questions, please feel free to contact me by telephone (416) 978-1578 or by email at christine.covell@utoronto.ca or Dr. Souraya Sidani at (416) 979-5000 extension 2572 or by email at ssidani@ryerson.ca.

Sincerely,

Christine L. Covell RN, MSN, PhD Candidate
Lawrence Bloomberg Faculty of Nursing
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto; and Canadian Research Chair-Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
email: ssidani@ryerson.ca
Telephone: (416) 979-5000 ext. 2572
Appendix G. Nursing Intellectual Capital Study Final Email for Unit Managers

University of Toronto

Email Header

Date

Dear Unit Manager,

During the last two months we have sent you several communications about a research study we are conducting. Its purpose is to determine the relationship of nurses’ knowledge skills and experience and with quality of care.

We are sending this final contact to remind you to complete the survey you received and return it at your earliest convenience.

We also want to assure you that your participation in this study is voluntary, and if you prefer not to respond, please return the blank survey. Your responses to the survey will be kept confidential.

We appreciate your willingness to consider our request.

If you require a copy of the survey, please call Christine Covell at (416) 978-1578 or email her at christine.covell@utoronto.ca.

Thank you, in advance, for considering our request.

Sincerely,

Christine L. Covell RN, MSN, PhD
Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto
and Canadian Research Chair
Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
Appendix H. Nursing Intellectual Capital Study Thank you/Reminder Email for Hospital Personnel

University of Toronto

Email Header

Date

Dear Hospital Employee,

Last week data collection forms were given to you that ask you to collate and transcribe financial, human resource or risk management data for specified hospital units.

If you have already completed and returned the forms, please accept our sincere thanks. If not, please do so at your earliest convenience. We are especially grateful for your help because it is only by obtaining the financial, human resource and risk management data that we will be able to understand the work environment, the support registered nurses receive for developing their knowledge and skills, and the influence they have on outcomes.

If you require a copy of the data collection forms, please call Christine Covell at (416) 978-1578 or email her at christine.covell@utoronto.ca.

Sincerely,

Christine L. Covell RN, MSN, PhD
Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto
and Canadian Research Chair
Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
Appendix I. Nursing Intellectual Capital Study Letter Accompanying Replacement Financial/Human Resource and Risk Management Unit Measures Data Collection Forms

University of Toronto

Email Header

Date

Dear Hospital Employee’s Name

About three weeks ago data collection form(s) were given to you that asked about financial, human resource or risk management information for specified hospital units.

If you have already completed and returned the form, please accept our sincere thanks. If you did not complete the form, please, find attached a copy of the form for you to complete at your earliest convenience.

Please note that cover sheet is attached to the form that identifies the specific unit for which we require data. The cover sheet will be removed and a code number will be assigned when the completed forms are returned to the researcher in order to protect confidentiality of the units.

Your assistance in providing the data is very much appreciated. The data will contribute to our understanding of the influence of nurses’ knowledge, skills, and experience to quality care.

If you have any questions about the information required, please feel free to contact Christine by telephone (416) 978-1578 or by email at christine.covell@utoronto.ca or Dr. Souraya Sidani at (416) 979-5000 extension 2572 or by email at ssidani@ryerson.ca

Sincerely,

Christine L. Covell RN, MSN, PhD
Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto
and Canadian Research Chair
Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
Dear Hospital Employee,

During the last two months we have sent you several communications about an important research study we are conducting. Its purpose is to determine the relationship of nurses’ knowledge, skills and experience and the factors within the work environment that influence their impact on outcomes.

We are sending this final contact to the hospital personnel that have not responded because we feel that they may have different feedback. Hearing from all of the hospital personnel helps us assure that the results are as accurate as possible.

We appreciate your willingness to consider our request as we conclude this effort to better understand the nurses’ knowledge, skills and experience and the factors within the work environment that influence their impact on outcomes. Thank you very much.

If you did not receive the data collection forms, or if it was misplaced, please call Christine Covell at (416) 978-1578 or email her at christine.covell@utoronto.ca and she will get another one to you today.

Sincerely,

Christine L. Covell RN, MSN, PhD
Candidate
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 340
Toronto, Ontario, M5T 1P8

Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto
155 College Street, Suite 376
Toronto, Ontario, M5T 1P8
Appendix K. Hospital Consent Form

Lawrence Bloomberg Faculty of Nursing
University of Toronto Letterhead

Hospital Consent Form

Title: The relationship of nursing intellectual capital to the quality of patient care and the recruitment and retention of registered nurses.

Investigators: Souraya Sidani, PhD, RN, Professor, Lawrence Bloomberg Faculty of Nursing, University of Toronto; Canadian Research Chair, Ryerson University

Christine Covell RN, PhD Candidate, Lawrence Bloomberg Faculty of Nursing
University of Toronto

Site Investigator: (Chief nursing officer or delegate)

Funding Source: Nursing Health Services Research Unit, University of Toronto Site

We are inviting the hospital to participate in a research study. Before agreeing that the hospital will participate in this study, it is important that you read and understand the following explanation of the proposed study procedures. The following information describes the purpose, procedures, benefits, inconvenience, risks and precautions associated with this study. It also describes the hospital’s right to refuse to participate or withdraw from the study at any time. In order to decide whether you will give permission for the hospital to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is known as the informed consent process. Please ask the researcher to explain any words you don’t understand before signing this consent form. Make sure all your questions have been answered to your satisfaction before signing this document.

Background
The hospital is being asked to participate in a study designed to determine the contribution of nurses’ knowledge, skills and experience to patient and organizational outcomes. The study will help the investigators determine under what work conditions employer investment in the knowledge and skill development of nurses affects the quality of patient care and the recruitment and retention of registered nurses.

Purpose and Objectives
The primary purpose of this study is to determine the relationship between nurses’ knowledge, skills and experience and the quality of patient care and the recruitment and retention of registered nurses within acute care hospitals.

What is Involved
If you agree, the hospital will be asked to provide financial, human resource and risk management data for selected nursing units of the hospital. Hospital personnel will be required to extract, collate the data and transcribe the information on to the provided forms. The data are about number of nursing staff, nursing staff earned hours, time paid off for nursing staff to learn, and rates of patient falls, infection, and medication error. Units that will be included in the study are inpatient acute care units with an average length of stay greater than 24 hours and a mean patient
of age of greater than 2 years. The unit managers of these units will be asked to complete a short survey about 1) the professional preparation and experience of registered nurses, and 2) the support the registered nurses received for developing their knowledge and skills in the last fiscal year. Information will also be collected from the unit managers about the characteristics (clinical specialty, number of beds) of the units.

**Potential Risks and Benefits**
There are no anticipated risks of providing the information, completing the survey or forms to the hospital or the unit managers. All potentially identifying information will be coded and the results will be presented for the total sample of units. There is no direct benefit to the hospital and unit managers. However, the results of this study could guide decision-making and/or policies related to the continuing professional development of registered nurses.

**Compensation**
The hospital will be offered an incentive of $10.00 per unit as acknowledgement for the time hospital personnel spend in extracting and collating financial, human resources, and risk management data. The hospital incentive will be provided at the beginning of the data collection period for the hospital. The unit managers will also be recognized for the time and effort given to completing the survey by the provision of a $2.00 coffee coupons with the initial distribution of the unit manager survey.

**Confidentiality**
All information collected for the study will remain strictly confidential. The hospital will not be directly associated with the information given. The hospital and units will be identified only with code numbers assigned by the researcher. The code sheet linking the hospital and units with the data will be kept in a locked file separate from the data. Only the researcher will have access to the code sheet. The code sheet will be destroyed by shredding once the data are entered into the computerized database. No hospital names or identifying information will be used in any publication or presentations.

**Participation**
The hospital’s participation in this study is voluntary. The hospital can choose not to participate or it may withdraw at any time without any explanation or any penalty. If the hospital does withdraw from the study the data will used only if the hospital gives permission.

**Researcher’s Relationship with Participating Hospitals**
At the time of the study the University of Toronto investigators are not employed by the hospital.

**Dissemination of Results**
It is anticipated that the results of this study will be presented as part of the PhD Student’s thesis, publications in professional journals and presentations at scholarly conferences or meetings related to the substantive topic. Results of the study, based on the total sample, will be provided to the hospital at the completion of the study in the form of a research brief.

**Questions**
If you have any questions about this study you may contact Ms. Christine Covell at 416-978-1578 or via email at christine.covell@utoronto.ca. For further questions, Dr. Souraya Sidani may be contacted at (416) 979-5000 extension 2572 or at ssidani@ryerson.ca. Should you have any question about hospital rights as a study participant, please feel free to call Research Administration at ______________.
Consent
I have read this consent form, and I agree for the hospital to participate in the research study “The relationship of nursing intellectual capital to the quality of patient care and the recruitment and retention of registered nurses”. My signature below indicates that I understand the above conditions of participation in this study and that I have had the opportunity to have my questions answered by the researcher. I voluntarily consent for the hospital to take part in the study with the understanding the hospital may withdraw at any time without penalty. I have received a signed copy of this consent form.

Name of Participant  Signature  Date

I confirm that I have explained the nature and purpose of the study named above. I have answered all questions.

Name of Researcher Obtaining Consent  Signature  Date

Please indicate if you wish to receive a copy of the final report.  NO  YES

If so, please send it to: ______________________________

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Declaration of Consent
_______________________________________ __________________________
Participant     (Print Name)    Date

_______________________________________ __________________________
Person obtaining consent (Print Name)    Date

☐ I have been given a copy of this consent form.
Appendix L. Nursing Intellectual Capital Study Disclaimer Letter for Unit Managers

Lawrence Bloomberg Faculty of Nursing

University of Toronto Letterhead

Nursing Intellectual Capital Study
Disclaimer Letter for Unit Managers

Date

Dear Unit Manager,

I am writing to invite you to participate in the study, “Relationship of nursing intellectual capital to the quality of patient care and the recruitment and retention of registered nurses”. The purpose of the study is to determine the relationship between nurses’ knowledge, skills and experience and the quality of patient care and the recruitment and retention of registered nurses within acute care hospitals. This study has been funded by the Nursing Health Services Research Unit, University of Toronto Site. Approximately 15 acute care hospitals and 230 unit managers from the provinces of Ontario and Quebec will be participating in this study.

I am a doctoral student at the University of Toronto, Lawrence Bloomberg Faculty of Nursing. I am conducting this study in partial fulfillment of the requirements of The Doctor of Philosophy (Nursing Health Services Research) degree.

This study requires data collection from two sources, hospital databases and a survey of unit managers. The hospital has agreed to participate in this study and has identified specific hospital personnel who will be responsible for providing financial, human resource and risk management data for selected hospital units.

You have been selected to participate because you have been identified as a unit manager of one of the selected units. You are eligible to participate if your unit:

- Has an average patient length of stay greater than 24 hours
- Has an average patient age greater than 2 years

Your participation is completely voluntary. Your involvement would consist of completing the enclosed survey and returning it in a pre-stamped envelope; or it can be picked up by the researcher. The survey inquires about 1) the professional preparation and experience of registered nurses employed on the unit, 2) support the registered nurses received for developing their knowledge and skills in the last fiscal year, and 3) characteristics of the unit in terms of clinical specialty and number of beds. The survey
will take approximately 30-45 minutes to complete. Your answers are confidential and your name and unit are not required on the survey. You may refuse to answer any of the questions and you may choose not to participate by returning a blank survey. The surveys will be kept in a locked file cabinet at the University of Toronto for five years after which they will be destroyed by shredding.

There are no known risks or benefits of completing the survey. All potentially identifying information will be coded and the results will be presented for the total sample of units. There is no direct benefit to you. However, the results of this study could guide decision-making and/or policies related to the continuing professional development of registered nurses.

You will not be paid for your time to complete the survey; however in recognition for the time and effort given to completing the survey a $2.00 coffee coupon will be distributed with the survey.

It is anticipated that the results of this study will be presented as part of the PhD Student’s thesis, publications in professional journals and presentations at scholarly conferences or meetings related to the substantive topic. The results of the study, based on the total sample, will be provided to the hospital at the completion of the study in the form of a research brief.

If you have any questions about this study you may contact Christine Covell or Dr. Souraya Sidani at the numbers listed below.

If you have any question about your rights as a research participant, you can talk to someone who is not involved in the study at all. That contact is Research Administration at ____________________________.

Thank you very much for your assistance with this study.

Christine L. Covell RN, MSN, PhD
Candidate
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University of Toronto
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email: christine.covell@utoronto.ca
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Souraya Sidani PhD, RN, Professor
Lawrence Bloomberg Faculty of Nursing
University of Toronto; and Canadian Research Chair-Ryerson University
350 Victoria Street
Toronto, Ontario, M5B 2K3
email: ssidani@ryerson.ca
Telephone: (416) 979-5000 extension 2572
Appendix M. Information Letter for Hospital Personnel Extracting Financial, Human Resource or Risk Management Data

Lawrence Bloomberg Faculty of Nursing
University of Toronto Letterhead

Information Letter for Hospital Personnel
Extracting Financial, Human Resource or Risk Management Data

Date

Dear Hospital Employee,

I am writing to inform you that the hospital has agreed to participate in the study, “Relationship of nursing intellectual capital to the quality of patient care and the recruitment and retention of registered nurses”. The purpose of the study is to determine the relationship between nurses’ knowledge, skills and experience and the quality of patient care and the recruitment and retention of registered nurses within acute care hospitals. This study has been funded by the Nursing Health Services Research Unit, University of Toronto. Approximately 15 acute care hospitals and 230 unit managers from the provinces of Ontario and Quebec will be participating in this study.

I am a doctoral student at the University of Toronto, Lawrence Bloomberg Faculty of Nursing. I am conducting this study in partial fulfillment of the requirements of The Doctor of Philosophy (Nursing Health Services Research) degree.

The hospital has agreed to take part in this study. This study requires data collection for selected units from hospital databases. The units that have been identified to participate in the study are units with:

- An average patient length of stay greater than 24 hours
- An average patient age greater than 2 years

The data for this study will be collected from existing hospital financial, human resource and risk management databases. You have been identified as an individual that will be responsible for providing the researchers with information about the selected units. The information needed for each selected unit relate to the number of nursing staff employed on the unit, nursing staff earned hours, time paid off for nursing staff to learn, and rates of patient falls, infection, and medication error.

Your involvement would consist of completing the enclosed data collection form and returning it in a pre-stamped envelope. The forms can also be picked up by the researcher. The form will be completed for each unit and take approximately 30-45 minutes per unit to complete. The information you provide is confidential and your name

and the unit name are not required on the data collection forms. The form for each unit will be coded and will be kept in a locked file cabinet at the University of Toronto for five years after which they will be destroyed by shredding.

There are no known risks or benefits of completing the forms. All potentially identifying information will be coded and the results will be presented for the total sample of units. There is no direct benefit to you. However, the results of this study could guide decision-making and/or policies related to the continuing professional development of registered nurses.

You will not be paid for the time to complete the forms; however in recognition for the time and effort given to completing the forms the hospital will be offered $10.00 per unit as an incentive.

It is anticipated that the results of this study will be presented as part of the PhD Student’s thesis, publications in professional journals and presentations at scholarly conferences or meetings related to the substantive topic. Results of the study, based on the total sample, will be provided to the hospital at the completion of the study in the form of a research brief.

If you have any questions about this study you may contact Christine Covell or Dr. Souraya Sidani at the numbers listed below.

If you have any question about your rights as a research participant, you can talk to someone who is not involved in the study at all. That contact is Research Administration at _______________________.

Thank you very much for your assistance with this study.

Christine L. Covell RN, MSN, PhD  
Candidate  
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Toronto, Ontario, M5B 2K3  
email: ssidani@ryerson.ca  
Telephone: (416) 979-5000 extension 2572
## Appendix N. Analysis of Variance for Unit Type

<table>
<thead>
<tr>
<th>Concept</th>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse Staffing</td>
<td>HPPD</td>
<td>2</td>
<td>20.27**</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Skill-mix</td>
<td>2</td>
<td>36.19**</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>RN-to-patient ratio</td>
<td>2</td>
<td>10.97**</td>
<td>88</td>
</tr>
<tr>
<td>Nursing Human Capital</td>
<td>Proportion of RNs with degrees</td>
<td>2</td>
<td>9.67**</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Proportion of RNs with certification</td>
<td>2</td>
<td>2.83</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Hours of CE attended by RNs</td>
<td>2</td>
<td>18.98**</td>
<td>81</td>
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<td></td>
<td>Professional experience of RNs</td>
<td>2</td>
<td>.921</td>
<td>74</td>
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<tr>
<td></td>
<td>RN unit tenure</td>
<td>2</td>
<td>.146</td>
<td>54</td>
</tr>
<tr>
<td>Employer Support for RN</td>
<td>Proportion of RNs received funding</td>
<td>2</td>
<td>4.41***</td>
<td>88</td>
</tr>
<tr>
<td>Nurse CPD</td>
<td>Time off to learn</td>
<td>2</td>
<td>.103</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Ratio of clinical educator-to-RN</td>
<td>2</td>
<td>7.53**</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>% of time RNs replaced</td>
<td>2</td>
<td>3.56***</td>
<td>86</td>
</tr>
<tr>
<td>Quality of patient care</td>
<td>Medication error rate</td>
<td>2</td>
<td>4.41**</td>
<td>84</td>
</tr>
<tr>
<td>outcomes</td>
<td>Patient falls</td>
<td>2</td>
<td>10.83**</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Hospital-acquired infections</td>
<td>2</td>
<td>.364</td>
<td>84</td>
</tr>
<tr>
<td>RN recruitment and retention</td>
<td>RN orientation hours</td>
<td>2</td>
<td>.364</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Vacancy rate</td>
<td>2</td>
<td>.399</td>
<td>89</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Turnover rate</td>
<td>2</td>
<td>1.56</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Recruitment rate</td>
<td>2</td>
<td>5.62**</td>
<td>90</td>
</tr>
</tbody>
</table>

*Note.* HPPD = hours per patient per day; RN = registered nurse, CE = continuing education; Unit type = Adult medical-surgical, long term-complex continuing care, specialty. **p < .01; ***p < .001
### Appendix O. Correlation Coefficients by Study Proposition

#### Correlation Coefficients for Nurse Staffing and Nursing Human Capital Variables

<table>
<thead>
<tr>
<th>Nurse Staffing Variables</th>
<th>Proportion of RNs with degrees</th>
<th>Proportion of RNs with Certification</th>
<th>Hours of CE attended by RNs</th>
<th>Professional experience</th>
<th>RN unit tenure rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPPD</td>
<td>.342**</td>
<td>.129</td>
<td>-.027</td>
<td>-.097</td>
<td>-.051</td>
</tr>
<tr>
<td>Skill-mix</td>
<td>.366**</td>
<td>.175</td>
<td>.298**</td>
<td>.075</td>
<td>-.055</td>
</tr>
<tr>
<td>RN-to-patient ratio</td>
<td>-.245*</td>
<td>-.326**</td>
<td>-.135</td>
<td>-.004</td>
<td>.110</td>
</tr>
</tbody>
</table>

*Note. HPPD = hours per patient per day; RN = registered nurse, CE = continuing education; ** $p < .01$, * $p < .05$.  

Correlation Coefficients for Employer Support for Nurse CPD and Nursing Human Capital Variables

<table>
<thead>
<tr>
<th>Employer Support for Nurse CPD Variables</th>
<th>Proportion of RNs with degrees</th>
<th>Proportion of RNs with Certification</th>
<th>Hours of CE attended by RNs</th>
<th>Professional experience</th>
<th>Unit tenure rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of RNs received funding</td>
<td>.224</td>
<td>.051</td>
<td>.248*</td>
<td>.199</td>
<td>.021</td>
</tr>
<tr>
<td>Time off to learn</td>
<td>.026</td>
<td>.133</td>
<td>-.032</td>
<td>.102</td>
<td>.061</td>
</tr>
<tr>
<td>Ratio of educators- to-RN</td>
<td>-.255*</td>
<td>.026</td>
<td>-.159</td>
<td>-.072</td>
<td>-.060</td>
</tr>
<tr>
<td>Percent of time RNs replaced</td>
<td>.154</td>
<td>-.070</td>
<td>.106</td>
<td>-.040</td>
<td>-.089</td>
</tr>
</tbody>
</table>

*Note. *p* < 0.05.*
### Correlation Coefficients for Nursing Human Capital and Quality of Patient Care Outcome Variables

<table>
<thead>
<tr>
<th>Nursing Human Capital Variables</th>
<th>Medication error rate</th>
<th>Patient fall rate</th>
<th>Hospital-acquired infection rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of RNs with degrees</td>
<td>.081</td>
<td>-.208*</td>
<td>-.227*</td>
</tr>
<tr>
<td>Proportion of RNs with Certification</td>
<td>-.040</td>
<td>-.123</td>
<td>-.230*</td>
</tr>
<tr>
<td>Hours of CE attended by RNs</td>
<td>-.007</td>
<td>-.130</td>
<td>.071</td>
</tr>
<tr>
<td>Professional experience</td>
<td>.001</td>
<td>-.019</td>
<td>-.193</td>
</tr>
<tr>
<td>RN unit tenure rate</td>
<td>-.026</td>
<td>.145</td>
<td>-.127</td>
</tr>
</tbody>
</table>

*Note. RN= registered nurse, CE= continuing education; *p < .05.*
Correlation Coefficients for Nursing Structural Capital and Quality of Patient Care Outcome Variables

<table>
<thead>
<tr>
<th>Nursing Structural Capital Variables</th>
<th>Medication error rate</th>
<th>Patient fall rate</th>
<th>Hospital-acquired infection rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidelines for prevention of medication errors</td>
<td>-.067</td>
<td>-.115</td>
<td>.041</td>
</tr>
<tr>
<td>Guidelines for prevention of patient falls</td>
<td>.079</td>
<td>.122</td>
<td>-.077</td>
</tr>
<tr>
<td>Guidelines for prevention of hospital-acquired infections</td>
<td>.047</td>
<td>.051</td>
<td>-.091</td>
</tr>
</tbody>
</table>
## Correlation Coefficients for Nursing Human Capital and RN Recruitment and Retention Outcome Variables

<table>
<thead>
<tr>
<th>Nursing Human Capital Variables</th>
<th>RN orientation hours</th>
<th>Vacancy rate</th>
<th>Turnover rate</th>
<th>Recruitment rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of RNs with degrees</td>
<td>-.071</td>
<td>-.048</td>
<td>-.033</td>
<td>-.110</td>
</tr>
<tr>
<td>Proportion of RNs with Certification</td>
<td>-.201</td>
<td>-.115</td>
<td>-.046</td>
<td>-.298&quot;&quot;</td>
</tr>
<tr>
<td>Hours of CE attended by RNs</td>
<td>.049</td>
<td>.003</td>
<td>.100</td>
<td>.013</td>
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<tr>
<td>Professional experience</td>
<td>-.361&quot;&quot;</td>
<td>-.074</td>
<td>-.092</td>
<td>-.130</td>
</tr>
<tr>
<td>RN unit tenure rate</td>
<td>-.221&quot;&quot;</td>
<td>-.234&quot;</td>
<td>-.073</td>
<td>-.335&quot;&quot;</td>
</tr>
</tbody>
</table>

*Note. RN = registered nurse, CE = continuing education; ** p < .01, * p < .05.*
References


A Randomized, Controlled Trial. *Journal of the American Geriatrics Society*, 53(8), 1296-1304.


