

**Title:** Nursing Intellectual Capital Theory: Operationalization and Empirical Validation of Concepts

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**Abstract**

**Aims:** This paper presents the operationalization of concepts in the nursing intellectual capital theory and the results of a methodological study aimed to empirically validate the concepts.

**Background:** The nursing intellectual capital theory proposes the stocks of nursing knowledge within an organization are embedded in two concepts, nursing human capital and nursing structural capital. The theory also proposes that two concepts within the work environment, nurse staffing and employer support for nursing continuing professional development influence nursing human capital.

**Methods:** A systematic three-step process was used to operationalize the concepts of the theory. In 2008, a cross-sectional design was used to collect data for 147 inpatient units from administrative departments and unit managers in 6 Canadian hospitals. Exploratory factor analyses were conducted to determine if the indicator variables accurately reflect their respective concepts.

**Results:** The proposed indicator variables collectively measured the nurse staffing concept. Three indicators were retained to construct nursing human capital: clinical expertise and experience concept. The nursing structural capital and employer support for nursing continuing professional development concepts were not validated empirically.

**Conclusion:** The nurse staffing and the nursing human capital: clinical expertise and experience concepts will be brought forward for further model testing. Refinement for some of the indicator variables of the concepts is indicated. Additional research is required with different sources of data to confirm the findings.

**Keywords:** Nursing Theory, Continuing Education, Human Capital, Nurse Staffing, Exploratory Factor Analysis

## **Summary Statement**

### **What is known about the topic:**

- Nursing knowledge and its relationship to patient and organizational outcomes is difficult to comprehensively evaluate.
- Theoretical and methodological issues used to examine the relationship between nursing knowledge and outcomes have contributed to inconsistent findings.
- Nursing intellectual capital theory attempts to address the theoretical and methodological issues by providing a comprehensive conceptualization of the stocks of nursing knowledge within an organization and their relationship to patient and organizational outcomes.

### **What this paper adds:**

- The conceptual-empirical structure of the nursing intellectual capital theory.
- Empirical validation of two concepts of the nursing intellectual capital theory.

### **Implications for practice and/or policy:**

- Data about the nurses' knowledge, skills and experience and the support organizations provide to nurses to update their knowledge are needed.
- Expanding existing or creating new databases that collate information about nurses to include information about the knowledge, skills and experience of nurses is recommended.

## **Introduction**

Nursing knowledge and its association with patient outcomes have been of interest to researchers and knowledge-users internationally for some time (Duffield et al 2011, Sasichay-Akkadechanunt et al. 2003, Tourangeau et al 2007). Recognized as inherently difficult to measure, nursing knowledge has traditionally been conceptualized to reflect the knowledge nurses gain from attending continuing professional development activities or the nursing staffs' level of academic preparation (Covell 2009). Several researchers have measured nurses' knowledge as the nursing staff's level of academic preparation (Aiken et al. 2011, Blegen et al. 2001, Tourangeau et al. 2007). Recently nurses' knowledge was represented as the proportion of nurses with specialty certification (Kendall-Gallagher & Blegen 2009, Krapohl et al. 2010). The findings of studies, conducted in different countries to investigate the relationships between nurses' knowledge and patient outcomes, were inconsistent. Several studies reported significant associations between nursing staff's knowledge and outcomes (Aiken et al. 2011, Kendall-Gallagher & Blegen 2009, Tourangeau et al. 2007) whereas others have not (Blegen et al. 2001, Krapohl et al. 2010, Sasichay-Akkadechanunt et al. 2003). Possible reasons for the inconsistencies include methodological and conceptual issues. Differences in the sources of data, unit of analysis, sample sizes and statistical methods employed to analyze the data account for the observed inconsistencies (Jiang et al. 2006, Clarke & Donaldson 2008). The absence of a comprehensive conceptualization of nursing knowledge within an organization contributed to the variability in the operationalization of this concept and hence, variability in results across studies.

The middle-range theory of nursing intellectual capital attempts to address some of these theoretical and methodological gaps by conceptualizing *the stocks* of nursing knowledge available within an organization and their direct relationships to patient and organizational outcomes. Consistent with the parent theory of intellectual capital (Bontis 1998), the nursing intellectual capital theory (Covell 2008) conceptualizes the stocks of nursing knowledge within an organization as nursing human capital and nursing structural capital. The nursing intellectual capital theory is unique in that it also highlights the contribution of the work environment to explain the relationship between nursing knowledge and outcomes.

In this paper, the operationalization of the key concepts in the nursing intellectual capital theory is presented for the purpose of facilitating their measurement in future research. After briefly clarifying the concepts of the theory, the processes used to develop the operational definitions and to select the indicators of each concept are described. Last, the results of a methodological study aimed at validating the indicators are reported. Empirically validating the operationalization of concepts prior to proceeding with examining their associations with outcomes is a particularly important step in testing the nursing intellectual capital theory. Potential errors in operationalization can be identified and corrective measures can be implemented prior to proceeding with testing the propositions of the theory (Costello & Osborne 2005) in different organizational contexts.

### **Background**

The middle-range theory of nursing intellectual capital was developed by using the strategies of theory derivation outlined by Walker and Avant (2010). Derived from intellectual capital theory, which is grounded in the fields of economics and accounting, the nursing intellectual capital theory conceptualizes the *stocks* of nursing knowledge in an acute care organization and

delineates its relationships with patient and organizational outcomes (for details, refer to Covell, 2008). Nursing knowledge is embedded in two concepts: nursing human capital and nursing structural capital. The theory also proposes that two environmental factors affect nursing human capital: nurse staffing and employer support for nursing continuing professional development (CPD). Of concern in this paper is the operationalization of the four concepts of the nursing intellectual capital theory, which are defined at the conceptual level next.

**Nursing human capital:** The nursing intellectual capital theory defines nursing human capital as the nursing knowledge that resides within the nursing staff. It encompasses theoretical and practical knowledge needed for the delivery of care. Nurses acquire theoretical and practical knowledge from obtaining academic degrees, participating in continuing education, in-service education, and specialty training. Nurses refine their practical knowledge through experience that is, working as a nurse (Covell 2008).

**Nursing structural capital:** Nursing structural capital is nursing knowledge converted into information structures that nurses can use to assist with their clinical decision-making and care planning (Covell 2008). Nursing structural capital in the form of practice guidelines, care maps or protocols is believed to provide relevant information to nurses for improving the quality of care they deliver (Miller & Kearney 2004, Ring et al. 2005).

**Nurse staffing:** Nurse staffing is the available supply of nurses who possess the theoretical and practical knowledge to competently care for patients on the unit (American Nurses Association [ANA] 1999). Nurse staffing as conceptualized for the nursing intellectual capital theory, reflects a stable base of nurses with the capabilities and expertise to provide the care required by the patients hospitalized on the unit (Covell 2008).

**Employer support for nurse continuing professional development (CPD):** Employer support for nurse CPD is the investment by the organization in the knowledge and skill development of nurses (Covell, 2008). Nurses report that after they enter the profession they require access to financial and human resources, such as bursaries and clinical nurse educators to update their knowledge and skills (Canadian Nurses Advisory Council 2002, Kramer & Schmalenberg 2004, Smith 2004, Hughes 2005).

### **Operationalization of Nursing Intellectual Capital Concepts**

Three steps were implemented during the process of operationalizing the four concepts. The steps entailed the specification of the critical attributes of the concepts, a review of pertinent literature, and the development of a conceptual – empirical structure.

#### **Step 1: Specification of critical attributes**

Critical attributes are elements that characterize a concept (Walker & Avant 2010). The attributes were derived from the respective concepts' definitions presented above. The critical attributes characterizing the nursing human capital concept are knowledge, skills and experience. Knowledge reflects the information gained through initial academic education and continuing education. Skills are expanded through specialty certification. Experience refers to the number of years nurses work as registered nurses, for a unit, and/or in a clinical specialty. The critical attributes of the nursing structural capital concept represent the availability of practice guidelines, care maps and protocols. Nurse staffing represents the complement of nurses, with different academic preparation and functions, available to provide patient care. It is operationalized by skill mix, hours per patient per day (HPPD) and RN-to-patient ratio. The critical attributes of employer support for nurse continuing professional development

encompasses the availability and use by nurses of financial resources (e.g., bursaries) and human resources (e.g., clinical educators) to expand their knowledge.

#### Step 2: Review of literature

The literature was reviewed to identify existing variables and the corresponding indicator variables reflective of the critical attributes of the four concepts (Walker & Avant 2010). The critical attributes were the keywords used to search the literature in the period of 1975 to 2007 for the purpose of identifying indicators of the attributes. The databases were: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Dissertation Abstracts International, Index Medicus and PsychINFO, as well as the World Wide Web for the gray literature consisting of reports from national, provincial and state regulatory and professional bodies. The search produced 61 papers that entailed empirical reports written in English and investigating the critical attributes of the human capital and structural capital. The decision to use empirical indicators available from relevant literature to quantify the concepts' critical attributes aimed at selecting validated indicators that showed content and construct validity; and hence minimize the potential for measurement error. Once validated indicators were identified, those accessible in databases maintained by acute care organizations, and generated with clearly delineated formulas, were chosen to reflect respective critical attributes.

The information on the data to be collected and the formula for quantifying the indicators was extracted from the literature. The information was critically analyzed to determine its relevance and suitability in accurately and comprehensively measuring the concepts' attributes as defined in the nursing intellectual capital theory. If an indicator could not be found that reflected the operational definition of an attribute as advanced by the theory a new one was created.



The indicator variables chosen to reflect the critical attributes of the nursing human capital concept were academic preparation, continuing education, specialty certification, professional experience, clinical specialty experience, and unit tenure. The critical attributes of the nursing structural capital concept were availability of practice guidelines, care maps or protocols for the prevention of patient falls, medication errors, and hospital-acquired infections.

The indicators of nurse staffing concept included concentration of registered nurses, RN-to-patient ratio and HPPD. The indicators of employer support for nurse CPD consisted of financial assistance, replacement, time off to learn and availability of clinical educator (Figure 1).

### Step 3: Development of a conceptual – empirical structure

The third step in the operationalization of the nursing intellectual capital concepts involved the development of a conceptual-empirical structure (Fawcett 1998). The structure was generated to maintain consistency in the conceptualization and operationalization of the concepts of the nursing intellectual capital theory. To determine the level of operationalization for the concepts, previously published intellectual capital theoretical literature was reviewed. Grantham et al. (1997) suggests the contribution of intellectual capital within acute care hospitals is most meaningful in areas where there are the greatest numbers of healthcare providers. Accordingly the concepts are best operationalized at the level of the inpatient unit. This unit of analysis is consistent with recent research on work environment and nurse staffing (Kalisch & Lee 2011). The conceptual-empirical structure of the nursing intellectual capital theory concepts is summarized in Table 1. The table outlines the concepts and their respective critical attributes, indicators and the corresponding formula for quantifying the indicators at the inpatient unit level.

The systematic three-step process for generating the conceptual-empirical structure maintained content validity of the selected empirical indicators. However it was critical to

examine the internal structure of concepts, that is, the extent to which the indicators accurately reflect their respective concepts. This was accomplished in an exploratory descriptive study. Data on the indicators selected for each concept were subjected to exploratory factor analysis, which aimed to substantiate the relevance of the indicators, that is, whether all indicators are needed to operationalize the concepts (Costello & Osborne 2005). The results will determine accurate specifications of the concepts' measurement in future test of the theory's propositions (Mulaik & Millsap 2000). This exploratory analysis is especially helpful for testing the measurement of newly hypothesized concepts which was the case for this study (Walker & Avant 2010).

### **A Methodological Study to Validate the Concepts**

#### **Aim**

The aim of the methodological study was to empirically examine the extent to which the selected indicators reflect the concepts of nursing human capital, nursing structural capital, nurse staffing, and employer support for nurse CPD. The goal was to identify the set of indicators that were most accurate in quantifying the respective concept.

#### **Design**

A cross-sectional design was used to collect data on the indicators of the theory's concepts (Table 1). To be consistent with the operationalization of the concepts of nursing intellectual capital theory, all data were obtained at the inpatient unit level and for one fiscal year.

#### **Setting**

Six acute care hospitals, representing university-affiliated institutions, located in large metropolitan areas of two provinces of Canada participated in the study. The institutions were

evenly distributed ( $n = 2$  in each category) among small (< 500 beds), medium (501-1000 beds) and large (> than 1000 beds) sized hospitals.

### **Sample**

As the theory's concepts were operationalized at the unit level, inpatient units within participating hospitals were targeted. Inpatient units with a patient age > 2 years and length of stay > 24 hours were selected to participate. A convenience sample of 147 inpatient units met the recommendations (i.e., 5-10 cases per predictor) for establishing adequate power when exploring relationships between concepts and their respective indicators (Norman & Streiner 2008). This sample size provided 9 cases per variable included in the analysis.

### **Data Collection Procedures**

In 2008, upon receiving approval from the participating hospitals' research ethics review board, data were obtained from administrative departmental databases for all eligible inpatient units. A short survey of unit managers was used to collect data on the unit characteristics and for indicator variables unavailable from the databases.

To ensure consistency in the data collected, clear and detail directions (available from the first author upon request) were given to the hospital departments and unit managers to guide the data extraction. Specific instructions clarified what exactly to include and/or exclude for each piece of information of which an indicator variable was comprised. The 16 indicator variables were quantified by applying the specific formula presented in Table 1.

### **Data Analysis**

Descriptive statistics were conducted to examine the frequency distribution, and measures of central tendency and dispersion for all variables (i.e., characteristics of units and indicators of concepts). Exploratory factor analysis (EFA) was applied (using SPSS 17) to examine accuracy

of the selected indicators in reflecting their respective concepts (Costello & Osborne 2005).

Principal axis factoring method with Varimax rotation was used to extract the factors. Principal axis factoring determines the amount of the variance shared among the indicators and that represent the concept commonly underlying the indicators (Norman & Streiner 2008).

The results of the EFAs were examined for potential factorability if the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was  $\geq .60$ . The KMO measure of sampling adequacy reflects the proportion of variance among the variables that may be shared. A factor was accepted if it had an eigenvalue of  $> 1$  and accounted for  $\geq 10\%$  of the variance in the indicators' values. The loadings 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 (2008).

### **Data Management**

Data were received for 139 inpatient units. The data were reviewed for entry mistakes, missing data or outliers. Entry mistakes were corrected by reviewing data collection forms and reentering the accurate value. The data were examined for skewness and normality of distribution. Responses for the variables were retained if they were within  $\pm 3$  standard deviations from the mean. Cases (inpatient units) were examined to determine the extent of missing data and removed from the analysis if they had greater than 15% missing data (Raymond, 1986). Indicator variables were excluded if more than 40% of the cases had missing data. With the application of strategies for addressing missingness the indicator variable of clinical specialty experience was eliminated from the analysis. In total, 47 units were excluded from the analysis providing a final sample of 91 inpatient units. This represented 62% of the 147 units originally sampled for this study.

## Results

### Unit characteristics.

The majority of the inpatient units were adult medical-surgical units; one-quarter were specialty units and one-quarter were long-term care units. The number of patient beds ranged from 6 to 64, with a mean of 27 ( $SD = 10.57$ ). Due to the inclusion of long-term care units with lengthy patient's hospitalizations, 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).

### Indicator variables.

As shown in Table 2, data on the indicator variables included in the final analysis were normally distributed. The nurse staffing concept was represented by HPPD, skill-mix and RN-to-patient ratio. The participating units had a mean of 7 HPPD of nursing care. On average, the unit skill-mix consisted of 67% RN, and had a RN-to-patient ratio of 1: 4.

Several variables were used to reflect the indicators of the nursing human capital concept. On average one third of the RNs on the participating units held university degrees; 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 RNs attended a varying number of continuing education hours in the previous fiscal year.

The four indicators operationalizing employer support for the nurse CPD concept were financial assistance, replacement, time off to learn and clinical educator. On average employers provided financial support for 56% of the RNs to engage in continuing professional development activities. They also supported RNs' ongoing learning by providing approximately 15 hours paid time off to attend continuing professional development, and replacement staff 80% of the time

when the RNs were away from the unit to learn. The clinical educators-to-RN a ratio was .02 clinical educator FTE-to-1 RN FTE.

The nursing structural capital concept was measured with three indicator variables including availability of practice guidelines, care maps or protocols for the prevention of medication errors, patient falls and hospital-acquired infections. Majority of the units had practice guidelines, care maps or protocols for the prevention of medication errors (87%), patient falls (70%), and hospital-acquired infections (87%).

Since most units consistently reported having practice guidelines, care maps or protocols for the prevention of patient falls, medication errors and hospital-acquired infections, the data for these variables were highly skewed. Highly skewed data are not suitable for exploratory factor analysis (Norman & Streiner, 2008).

### **Results of the exploratory factor analyses.**

In this section the results of the exploratory factor analysis are presented for each concept. Due to skewness of responses pertaining to the availability of guidelines, care maps and protocols for the prevention of patient falls, medication errors and hospital-acquired infections on their units, these indicators could not be subjected to EFA to determine their validity in operationalizing nursing structural capital concept.

*Nursing human capital:* The KMO measure of sampling adequacy was .54 below the recommended 0.6. The five indicators did not load on to one factor. However the eigenvalues and scree plot suggested a two-factor model. Three indicators, specialty certification (factor loading = .32), professional experience (.58) and 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 indicators loaded on to the second factor: continuing education (.71) and

academic preparation (.19). The second factor had an eigenvalue of 1.14 and accounted for 11.25% of the variance.

EFA was used to retest the factorial structure of each emerging factor. For the first factor with three indicators, the KMO measure of sampling adequacy was .6. The three indicators continued to load on to one factor: specialty certification (.35), professional experience (.51) and unit tenure (.70). This factor had an eigenvalue of 1.5 and accounted for 26.9% of the variance. This factor captured nurses' clinical expertise. For the second factor with two indicators, the KMO measure of sampling adequacy was .5. The two indicators loaded on to one factor, RN with degrees (.36) and hours of CE (.36). The factor had an eigenvalue of 1.15 and accounted for 15% of the variance. This factor captured nurses' knowledge.

***Nurse staffing:*** The KMO measure of sampling adequacy was .64, above the recommended 0.6 and the scree plot suggested one factor. The three indicators of the nurse staffing concept loaded on one factor: skill-mix (.68), RN-to-patient ratio (-.72) and HPPD (.51). The factor had an eigenvalue of 1.27 and accounted for 42% of the variance in the empirical indicators. The nurse staffing concept was empirically validated.

***Employer support for nurse CPD:*** The KMO measure of sampling adequacy was .50 below the recommended 0.6 and the scree plot did not support a one factor structure. The four indicators of the employer support for nurse CPD concept did not load (loadings  $\leq$  .30) on to one factor. The findings imply that employers may use a select number of or different combinations of strategies to support nurses' CPD but not all those reflected in the selected indicators.

## **Discussion**

The overall purpose of this paper was to present the operationalization and the results of the methodological study designed to empirically validate the concepts of the nursing intellectual

capital theory. The specific study aim was to examine the extent with which the proposed indicator variables reflect the nursing intellectual capital concepts and ultimately to identify the indicators that validly measure their respective concepts.

Overall, the findings from this study provide preliminary evidence validating the operationalization of two nursing intellectual capital concepts. The factorial structure of the nurse staffing concept was consistent with the conceptual and operational definitions advanced in the nursing intellectual capital theory, whereas the factorial structure of nursing human capital deviated slightly from the one delineated in the theory. The proposed factorial structure of employer support for nurse CPD did not hold. Limited variability in responses precluded investigation of the factorial structure for the nursing structural capital.

**Nurse staffing:** 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 supply of nurses who possess the knowledge, skills and experience to competently meet the care need of the patients on the unit (ANA 1999, Covell 2008). 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: Covell 2008). The negative loading of RN-to-patient ratio and the positive loading of HPPD and skill mix indicate that a low RN-to-patient ratio (i.e., RNs care for fewer patients per shift), more hours of patient care per pay, and high proportion of RNs define a rich complement of nurses available to provide care to patients.

**Nursing human capital:** The two emerging factors are theoretically meaningful. The first factor reflects nurses' practical knowledge (specialty certification, professional experience and unit tenure), and the second factor represents theoretical knowledge that nurses acquire through



formal learning activities (academic preparation and continuing education). The measurement of the concept's attributes is limited as the current indicators reflect formal nursing knowledge and do not attempt to measure the knowledge nurses acquire informally through collaboration with colleagues.

Although specialty certification is representative of knowledge, skills and experience in a specialty, it may not be applicable to all types of units, organizations or countries. This attribute was not relevant to a large number of inpatient units that participated in this study (e.g. long term and general medical-surgical), evidenced by the high percentage of missing data. Therefore, in future research, consideration could be given to an attribute that captures general nursing expertise and measure it with indicators that reflect Stages of Skill Acquisition (Benner et al. 2009), clinical ladders echelons or employment grades (Duffield et al 2011) that are pertinent within and across countries.

**Employer support for nurse CPD:** The factorial structure for the employer support for nurse CPD was not validated. The variables of the employers support for nurse CPD concept, financial assistance, time off to learn, clinical educator and replacement, represented a range of strategies that can be used to assist nurses. The findings suggest that organizations apply one or a specific combination of, but not necessarily all of these strategies to demonstrate their commitment to nurse continuing professional development. Thus, quantifying the concept with the number of strategies used by the organization may better capture the amount of support employers provide to nurses to develop their knowledge and skills. An alternative indicator could reflect the amount of financial investment an organization provides to RNs; which is consistent with the propositions of parent intellectual capital theory. These newly proposed indicators should be validated in future research.

**Nursing structural capital:** The conceptualization and proposed indicators of the nursing structural capital variable were limited by the theoretical and empirical literature available at the time of its derivation. Therefore the conceptual and empirical literature should be revisited and alternate operational definitions and indicator variables that provide alternate measures of the nursing structural capital concept should be explored. Thought may be given to refining the nursing structural capital concept to reflect the nurses' use of practice guidelines, 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) . Consideration could also be given to measuring the number of knowledge structures available to nurses.

### **Implications for Research**

The systematic process followed in the operationalization of the nursing intellectual capital concepts maintained the content validity of the selected indicators. The conceptual – empirical structure and the detailed directions for data extraction facilitated the consistent generation of information on the respective indicators. Application of the formulae proposed in the structure will contribute to standardization of indicators in future research, and hence to consistent results across studies concerned with testing the propositions of the theory within different contexts.

Findings of this methodological study supported the operationalization of the nurse staffing concept. This is first time that nurse staffing has been conceptualized as an independent entity and measured as a unified concept. This conceptualization and validated operationalization imply that the three staffing indicators (HPPD, skill-mix and RN-to-patient ratio) are needed to comprehensively measure the amount of nurse staffing on a unit (Kalisch et al. 2011). Future testing of the nurse staffing concept by replicating the factor analysis with different samples of

units from different types of hospitals and countries is necessary to determine if the indicators continue to accurately capture the concept. Using comprehensive, valid and reliable indicators of nurse staffing has the potential for creating a consistent body of empirical evidence thus addressing the conflicting results reported in the literature, which have been attributed to the varying operationalizations of this concept (Jiang, et al. 2006, Clarke & Donaldson 2008).

The results indicated that nursing human capital is best operationalized in knowledge and clinical expertise of nurses. Therefore these two concepts should be investigated in future testing of the theory's propositions. Alternate indicators of employer support for CPD and of nursing structural capital, as suggested in previous sections, should be explored.

### **Implications for Practice**

The amount of data missing or unavailable to this study implies that improved documentation of nurses' knowledge, skills and experience is needed. The existing databases in Canada do not include information regarding the amount of type of continuing education nurses participate in after they enter the profession. There is also limited documentation of the type of financial and human resources provided by employers to support the knowledge and skill development of nurses. Consideration could be given for organizations, managers or professional organizations to record this information in existing databases or constructing new databases that comprehensively reflect the knowledge, skills and experience of nurses and the resources used to support CPD. This type of data may assist governments, organizations and managers internationally with human resource development, management and planning.

### **Implications for the Theory**

The study represents an initial step towards testing the nursing intellectual capital theory. The findings indicate some of the indicator variables may not reflect their respective concepts. These

results could have occurred for two reasons arising from the conditions under which the concepts were tested (Walker & Avant 2010). The characteristics of the selected units and the availability of data for some of indicators may have influenced the results. Since an accumulated body of empirical evidence is required to refute or verify the theory additional tests of the theory with varying types of units and data are required (Fawcett 2005, Walker & Avant). Until such evidence is generated, the nursing intellectual capital theory may be useful for guiding research or practice related to the contribution of nursing knowledge to patient and organizational outcomes.

### **Study Strengths and Limitations**

The limitations of this study relate to the sample and sources of data. The final sample used to empirically test the validity of the concepts consisted of 91 inpatients from six hospitals in Canada. Approximately one-third of the units were lost due to missing data, which could have introduced sample selection bias. Additionally the sample size used to empirically validate the concepts was slightly lower than estimated, but the ratio of indicator-to-cases (7) was still within the recommended range (5-10) for EFA (Norma & Streiner 2008). The study should be replicated with a larger sample representative of inpatient units from variety of hospitals and countries to determine the robustness of the findings.

The methods used to obtain and manage the data were strengths of this study. Since at the time of the study, existing databases did not contain all of the variables of interest, it was necessary to collect the data from numerous sites and inpatient units. To ensure reliability of the data considerable effort was made to ensure precision in the data provided for each variable which increased the validity of the study conclusions.

## **Conclusion**

A systematic process was applied to generate clear conceptual and operational definitions for the concepts of the nursing intellectual capital theory. Carefully selected variables and empirical indicators reflected the intended meaning of the concepts attributes. Clear instructions guided data collection and enhanced the accuracy of the obtained data. Results of the exploratory factor analyses provide evidence that can be used when testing the propositions of the nursing intellectual capital theory.

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**Table 1. Conceptual - Empirical Structure of the Nursing Intellectual Capital Theory**

Concept	Critical Attributes	Indicator Variable	Empirical Definition	Empirical Indicator
Nursing human capital	Nurses' knowledge & skills	Academic preparation	Proportion of RNs with degrees	Number of RNs with BN or higher/Total number of RNs
Nursing human capital	Nurses' knowledge, skills & experience	Specialty certification	Proportion of unit RNs with specialty certification	Number of RNs with Specialty Certification/ Total number of RNs
Nursing human capital	Nurses' knowledge & skills	Continuing education	The number of hours of CE attended by unit RNs	Total number of hours of CE attended by unit RNs
Nursing human capital	Nurses' skills & experience	Professional experience	The unit RN professional experience rate (mean number of years of unit RNs professional experience)	Total number of years of RN professional experience/Total number of RNs
Nursing human capital	Nurses' skills & experience	Clinical specialty experience	The unit RN clinical specialty experience rate (mean number of years of unit RN clinical specialty experience).	Total number of years of RN clinical specialty experience/ Total number of RNs
Nursing human capital	Nurses' skills & experience	Unit tenure	The unit RN unit tenure rate (mean number of years of unit RNs seniority or tenure with the unit)	Total number of years of RN unit tenure (seniority)/Total number of RNs

**Table 1 continued. Conceptual - Empirical Structure of the Nursing Intellectual Capital Theory**

Concept	Critical Attributes	Indicator Variable	Empirical Definition	Empirical Indicator
Nursing structural capital	Practice guidelines, care maps & protocols	Availability of practice guidelines, protocols or care maps	Availability of practice guidelines, protocols or care maps for the prevention of patient falls	Availability of practice guidelines, protocols or care maps for the prevention of patient falls
Nursing structural capital	Practice guidelines, care maps & protocols	Availability of practice guidelines, protocols or care maps	Availability of practice guidelines, protocols or care maps for the prevention of medication errors	Availability of practice guidelines, protocols or care maps for the prevention of medication errors
Nursing structural capital	Practice guidelines, care maps & protocols	Availability of practice guidelines, protocols or care maps	Availability of practice guidelines, protocols or care maps for the prevention of hospital-acquired infections	Availability of practice guidelines, protocols or care maps for the prevention of hospital- acquired infections
Nurse staffing	Concentration of registered nurses	Skill-mix	The proportion of RN hours to nursing staff hours.	In-patient RN earned hours/RN + RPN + non-professional earned hours
Nurse staffing	Registered nursing care per patient	RN-to-patient ratio	The mean number of patient cared for by one RN day shift	RN to patient ratio for days (weekdays & weekends)

**Table 1 continued. Conceptual - Empirical Structure of the Nursing Intellectual Capital Theory**

Concept	Critical Attributes	Indicator Variable	Empirical Definition	Empirical Indicator
Nurse staffing	Supply of nurses	Hours per patient per day (HPPD)	Total in-patient worked hours (excluding hours for benefits) used for all unit staff including purchased hours for float, agency staff or sitters per patient day.	Total nursing care worked hours/patient day
Employer support for nurse continuing professional development	Financial resources	Financial assistance	Mean number of unit RNs who received financial assistance from the organization to attend CPD activities.	Number of RNs that received financial assistance from hospital to attend CPD activities/Total number of RNs
Employer support for nurse continuing professional development	Human & financial resources	Replacement	Provision of replacement staff for RNs while they are away to learn	Percent of time the RNs are replaced when away from the unit to learn.
Employer support for nurse continuing professional development	Financial resources	Time off to learn	Proportion of nursing staff hours used for RNs to attend CPD activity plus the total number of unpaid hours or absences allocated for RNs to learn including unpaid study leaves.	Total number of earned hours of paid & unpaid time off (or absences) allocated to RNs for time off to attend CPD activities/Total in-patient nursing earned hours

**Table 1 continued. Conceptual - Empirical Structure of the Nursing Intellectual Capital Theory**

Concept	Critical Attributes	Indicator Variable	Empirical Definition	Empirical Indicator
Employer support for nurse continuing professional development	Human resources	Clinical educator	Ratio of clinical nurse educators to RNs.	Number of FTE clinical educators/ Number of RN FTE

*Note.* RN(s) = registered nurse(s); BN = Bachelors Degree in Nursing; CPD = continuing professional development; earned hours = productive & nonproductive; FTE(s) = full time equivalent(s). CE= continuing education. Some of the definitions & indicators have been obtained or adapted from Edvinsson & Malone (1997), Lankshear, Sheldon & Maynard (2005), McGillis Hall (2003), Stewart (2001).

**Table 2. Frequency Distribution for Continuous Indicator Variables**

Concept	Indicator Variables	N	Mean (SD)	Minimum	Maximum
Nurse Staffing	HPPD	83	7.11 (3.44)	.60	18
	Skill-mix	91	.67 (.19)	.11	1.00
	RN-to-patient ratio	89	4.13 (1.50)	1.00	8
Nursing Human Capital	Academic Preparation	90	.34 (.21)	.00	1.00
	Specialty Certification	90	.10 (.13)	.00	.59
	Continuing Education	82	1371 (1733)	16	7400
	Professional Experience	75	12.05 (4.88)	2.34	26
	Unit Tenure	55	5.74 (2.93)	.94	12
Employer Support for Nurse CPD	Financial Assistance	89	.56 (.39)	.00	1.00
	Time off to learn	85	14.96 (11.71)	.00	55
	Clinical Educators	86	.02 (.02)	.00	.06
	Replacement	87	79.51 (30.04)	.00	1.00

**Figure 1. Model of the Conceptual-Empirical Structure for the Nursing Intellectual Capital Theory**

