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Relationship of nursing diagnoses, nursing outcomes, and nursing interventions for patient care in intensive care units

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RELATIONSHIP OF NURSING DIAGNOSES, NURSING OUTCOMES, AND NURSING INTERVENTIONS FOR PATIENT CARE IN INTENSIVE CARE UNITS

By

Mikyung Moon

An Abstract

Of a thesis submitted in partial fulfillment of the
requirements for the Doctor of Philosophy degree
in Nursing in the Graduate College of
The University of Iowa

July 2011

Thesis Supervisor: Professor Sue Moorhead

ABSTRACT

The purpose of the study was to identify NANDA - I diagnoses, NOC outcomes, and NIC interventions used in nursing care plans for ICU patient care and determine the factors which influenced the change of the NOC outcome scores. This study was a retrospective and descriptive study using clinical data extracted from the electronic patient records of a large acute care hospital in the Midwest. Frequency analysis, one-way ANOVA analysis, and multinomial logistic regression analysis were used to analyze the data. A total of 578 ICU patient records between March 25, 2010 and May 31, 2010 were used for the analysis. Eighty - one NANDA - I diagnoses, 79 NOC outcomes, and 90 NIC interventions were identified in the nursing care plans. *Acute Pain - Pain Level - Pain Management* was the most frequently used NNN linkage. The examined differences in each ICU provide knowledge about care plan sets that may be useful. When the NIC interventions and NOC outcomes used in the actual ICU nursing care plans were compared with core interventions and outcomes for critical care nursing suggested by experts, the core lists could be expanded. Several factors contributing to the change in the five common NOC outcome scores were identified: the number of NANDA - I diagnoses, ICU length of stay, gender, and ICU type.

The results of this study provided valuable information for the knowledge development in ICU patient care. This study also demonstrated the usefulness of NANDA - I, NOC, and NIC used in nursing care plans of the EHR. The study shows that the use of these three terminologies encourages interoperability, and reuse of the data for quality improvement or effectiveness studies.

Abstract Approved:

Thesis Supervisor

Title and Department

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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the Ph.D. thesis of

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has been approved by the Examining Committee
for the thesis requirement for the Doctor of
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This dissertation is dedicated

to my family, especially, my loving parents,
who gave me endless encouragement and believed my ability

Also to my advisor,
Professor Sue Moorhead,
who gave me constant support and guidance during my doctoral study

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CHAPTER I

BACKGROUND AND SIGNIFICANCE

Introduction

Nurses working in intensive care units (ICUs) need to have specialized knowledge, skills, and experience to provide timely, appropriate care to critically ill patients with complex care problems (Stone et al., 2009). However, the variations in nursing resource consumption in ICU settings are disregarded in current diagnosis related groups (DRGs), reimbursements, and the per diem hospital charging systems (Sullivan, Carey, & Saunders, 1988). In addition, some care activities provided by nurses are often billed under the physician's name (Griffith & Robinson, 1992). Therefore, in response to this situation, revealing the contributions of nursing care to ICU patient outcomes is one of the most pressing concerns of nursing professionals.

Furthermore, with the United States population aging, Medicare spending for critical care settings such as ICUs has increased at rates much higher than the charges for other nursing departments and amounts to around 33% of total Medicare spending ("Medicare inpatient", 2007; Milbrandt et al., 2008). However, the cost for ICU patient care often exceeds the average cost based on DRG reimbursement and, in particular, Medicare paid for only 83% of the cost of care for ICU patients in 2000 (Cooper & Linde-Zwirble, 2004; Halpern & Pastores, 2010). As a result, administrators are more concerned about cost containment activities and evidence based practices that will lead to the best patient outcomes using available hospital resources.

Statement of the Problem

In an effort to identify nursing care provided to ICU patients, there have been many studies conducted to describe specialized interventions or programs for ICU patient care and to evaluate the effect of those interventions (Ballard et al., 2008; Campbell, 2008; Coons & Seidl, 2007; Harrigan et al., 2006; O'Meara et al., 2008; Vollman, 2006). Only a few experts have listed the nursing interventions that are used in critical care settings (Bulechek, Dochterman, & Butcher, 2008; McCloskey, Bulechek, & Donahue, 1998). In addition, the studies still have some limitations including the failure to clearly identify actual nursing practices provided to ICU patients. The reasons for these limitations include focusing on a few special individual interventions (Campbell et al., 2008; Coons & Seidl, 2007; Harrigan et al., 2006; Vollman, 2006), using the physician's classification system as a tool (Griffith & Robinson, 1992), and using a survey methodology without clinical verification (McCloskey et al., 1998; Titler, Bulechek, & McCloskey, 1996).

In addition, because of the increased awareness of patient safety and quality of care in ICU settings, studies have described patient outcomes as quality measures of ICU patient care (Rudy et al., 1995; Siegele, 2009; Vollman, 2006; West, Mays, Rafferty, Rowan, & Sanderson, 2009), ICU mortality (Fridkin, Pear, Williamson, Galgiani, & Jarvis, 1996; Pronovost et al., 1999; Shortell et al., 1994), length of stay (Cady, Mattes, & Burton, 1995; Shortell et al., 1994), and readmission rates to hospital are the outcomes typically used to measure the quality of care in ICU settings as well as in many other settings (George & Tuite, 2008). Adverse events such as ventilator-associated pneumonia (VAP) or central-line bloodstream infections (BSI) are also considered as other outcomes

specific to ICU settings (Amaravadi, Dimick, Pronovost, & Lipsett, 2000; Hugonnet, Uckay, & Pittet, 2007; Robert et al., 2000; Whitman, Kim, Davidson, Wolf, & Wang, 2002). In addition, most of the nursing studies using these outcomes examine the impact of nurse staffing (Dang, Johantgen, Pronovost, Jenckes, & Bass, 2002; Fridkin et al., 1996; Robert et al., 2000; West et al., 2009) or organizational factors (Campbell et al., 2008; Pronovost et al., 1999) on patient outcomes. These outcomes studies were valuable for making decisions at the staff nurse level or identifying risk factors. However, the weakness of this previous research is that it does not show the unique contribution of nursing care to individual ICU patients' well-being because the outcomes are not linked to nursing interventions and are focused on unit level incidence or prevalence rates.

The recent integration of standardized nursing languages such as NANDA - International (NANDA - I), Nursing Outcomes Classification (NOC), and Nursing Interventions Classification (NIC) into nursing documentation makes it possible to capture all the contextual elements of the nursing care process and to document nursing care provided to patients. Moreover, the dataset using these classifications can also be used to identify the relationship between nursing interventions and nursing outcomes, which can help to evaluate the effectiveness of nursing interventions provided to patients (Maas & Delaney, 2004). A few nurse researchers have identified the types and patterns of nursing diagnoses, interventions and outcomes for specific groups of patients through using these classifications (Dochterman et al., 2005; Lunney, 2006b; Shever, Titler, Dochterman, Fei, & Picone, 2007). Other studies reveal the relationship between nursing interventions and patient outcomes such as length of stay or hospital cost (Shever et al., 2008; Titler et al., 2007; Titler et al., 2008). However, there is still a lack of studies using

clinical data with standardized nursing languages. In particular, there are no studies within the literature that identify and verify the pattern of nursing diagnoses, nursing outcomes and nursing interventions provided in ICU settings. Thus, no studies have been conducted to identify the impact of ICU interventions on nursing outcomes using these three classifications.

Purpose of the Study

The purpose of this study was to examine and verify the pattern of NANDA - I diagnoses, NOC outcomes, and NIC interventions for ICU patient care using clinical data documented using these classifications. The linkages among the three languages were explored. Moreover, as a basic step to identify the unique effect of NIC interventions on NOC outcomes, the factors which influence the change of the NOC outcome scores were determined.

Research Questions

1. What NANDA –I diagnoses are most frequently selected by nurses for ICU patient care?
2. What NOC outcomes are most frequently selected by nurses for ICU patient care? What is the change of the selected NOC outcome scores for ICU stay?
3. What types of NIC interventions are used most frequently over the ICU stay?
4. What linkages of NANDA - I, NOC and NIC are selected most frequently by nurses for ICU patient care?
5. How do the interventions and outcomes selected by nurses compare with core interventions and outcomes validated by experts?

6. What are the differences and similarities between how NANDA - I, NOC and NIC are used in the three different ICU settings?
7. What patient characteristics (age, gender, and ICU length of stay), clinical conditions (primary diagnosis and comorbid diseases), and nursing characteristics (ICU type, the number of NANDA - I diagnoses, nursing staff to patient ratio, and skill mix of nursing caregivers) are associated with the change of frequently selected NOC outcome scores?
8. What are the unique contributions of patient characteristics, clinical conditions, and nursing characteristics to the change of the selected NOC outcome sores?

Background

NANDA - I, NOC, and NIC

A standardized nursing language (SNL) is "a structured vocabulary that provides nurses with a common means of communication" (Beyea, 1999, p.831). The use of this SNL in nursing documentation can result in better continuity of care by improving communication among nurses (as well as between nurses and other healthcare providers), capture more nursing activities as evidence to determine nursing costs, provide standards for improving the quality of nursing care, and allow data collection which helps in evaluating the patient outcomes of nursing care (Bulechek et al., 2008; Henry, Holzemer, Randell, Hsieh, & Miller, 1997; Lunney, 2006a; Moorhead, Johnson, Maas, & Swanson, 2008; Rutherford, 2008). The importance of these SNLs is demonstrated through the emergence of electronic health records because the use of SNLs makes it possible to exchange data between information systems and create secondary data for further studies

(Lunney, Delaney, Duffy, Moorhead, & Welton, 2005; Westra, Solomon, & Ashley, 2006).

Since the NANDA - I classification was first developed in the 1970s, many studies have focused on the development and application of SNLs. Currently, 12 SNLs, developed uniquely to support nursing practice, are recognized by the Nursing Information and Data Set Evaluation Center (NIDSEC) of the American Nurses Association (ANA). Among these SNLs, NANDA - I, NOC, and NIC are often considered as a nursing terminology set because this unified set can be used to provide unique terms or labels for nursing diagnoses, nursing outcomes, and nursing interventions as elements of the nursing process. Compared to other SNLs such as the Omaha System (home care nursing) (Martin, 2004; Martin & Scheet, 1992) or the Perioperative Nursing Dataset (PNDS, peri-operative nursing) (AORN, 2007), this unified form of the NANDA - I, NOC, and NIC can be more comprehensively used across units and settings (Anderson, Keenan, & Jones, 2009). The studies related to these three languages have the most extensive penetration and author networks among the studies dealing with SNLs (Anderson et al., 2009). In particular, a survey study with 20 large nursing schools and 20 hospitals shows that these three languages are the most widely taught and utilized for clinical documentations in both groups (Allred, Smith, & Flowers, 2004). In addition, several studies support that the quality of nursing documentation is improved through the implementation of these three languages (Keenan, Tschannen, & Wesley, 2008; Lavin, Avant, Craft-Rosenberg, Herdman, & Gebbie, 2004; Müller-Staub, Needham, Odenbreit, Lavin, & van Achterberg, 2007).

Nursing Effectiveness Research using Standardized Nursing Languages (SNLs)

Effectiveness research provides evidence about the benefits, risks, and results of treatment so that healthcare providers, as well as, patients can make better decisions for the best possible patient outcomes (Hubbard, Walker, Clancy, & Stryer, 2002). Since healthcare delivery methods have changed with the development of the managed care environment in the 1990s, federal and third-party payers have begun to pay more attention to increasing healthcare providers' accountability for patient outcomes (Given & Sherwood, 2005; Ingersoll, McIntosh, & Williams, 2000). As a result, effectiveness research is an important topic in healthcare research today.

In nursing, most studies related to effectiveness research have been conducted to reveal the effect of nurse staffing on patient outcomes (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; West et al., 2009). The studies show that greater care time provided by registered nurses (RNs) is related to better patient outcomes. Patient factors such as age, gender, race and medical history are often used as covariates in this outcome research (Kane et al., 2007; West et al., 2009). These studies are meaningful for making decisions about appropriate staffing levels, which is often a target for hospital cost reduction. However, these studies are more focused on the structure of nursing care and do not show the unique effect of nursing interventions on patient outcomes.

With the emergence of health information systems recorded using standardized nursing languages, numerous pieces of data related to patient care can be collected in the information system. This clinical dataset can provide information about patient outcomes linked to interventions, and interventions driven by assessment (Charters, 2003). Therefore, the clinical dataset allows the identification of the nursing interventions that

lead to desired patient outcomes (Maas & Delaney, 2004; Ozbolt, 1992). As a result, the information from this clinical data can be used to develop knowledge related to the quality and cost of care in nursing units and to compare quality and cost across hospitals and time periods (Lunney, 2006a).

Critical Care Nursing in Intensive Care Units (ICUs)

Critical care nursing is a specialty within nursing that deals specifically with human responses to life-threatening problems (American Association of Critical-Care Nurses (AACN), 2010). Intensive care units (ICUs) are the most common area to provide critical care nursing. Three ICU categories, which are intensive care, premature/neonatal, and coronary care, account for about 90% of critical care beds in the United States and, currently more than 4 million patients are admitted to an ICU during a year (Halpern, Pastores, & Greenstein, 2004; Halpern & Pastores, 2010). Critical care nurses in this specialty area work with acutely ill patients who have a high risk of life-threatening health problems. Because critically ill patients are highly vulnerable, unstable, and complex, they need complex assessment, high-intensity therapies and interventions, and continuously vigilant nursing care (AACN, 2010; Harrigan et al., 2006). Therefore, critical care nurses need to have specialized knowledge, skills, and experience to provide appropriate and timely interventions to prevent costly and potentially fatal outcomes (Martin, 2002; Stone & Gershon, 2009).

A few studies have been reported in which nursing diagnoses were used in critical care nursing (do Vale, de Souza, & Carmona, 2005; Kuhn, 1991; Wieseke, Twibell, Bennett, Marine, & Schoger, 1994). In these studies, *Impaired Gas Exchange, Alteration in Comfort,* and *Altered Fluid Volume* were described as frequently used nursing

diagnoses in critical care settings. Wieske and colleagues (1994) examined critical care nurses' perceptions of frequently used nursing diagnoses and validated the content of defining characteristics of five selected nursing diagnoses in critical care settings. The nursing diagnoses examined in this research were *Impaired Skin Integrity, Activity Intolerance, Sleep Pattern Disturbance (adult), Sleep Pattern Disturbance (child),* and *Parent Role Conflict.*

Many studies about outcomes of critical care nursing have focused on patient safety and quality of care (Siegele, 2009; Vollman, 2006; West et al., 2009). ICU mortality, length of stay (Pronovost et al., 1999; Shortell et al., 1994), and adverse event rates, such as the rate of ventilators-associated pneumonia (VAP) and pressure ulcers, are typical types of outcomes examined to measure the quality of critical care. Unit based pressure ulcer incident rate, ventilator-associated pneumonia (VAP) rate, and bloodstream infection rates are referred to as nursing sensitive outcomes in ICU patient care (National Quality Forum (NQF), 2004; Whitman et al., 2002)

An early study to identify nurses' activities or interventions in critical settings used the Physician's Current Procedural Terminology (CPT) (Griffith & Robinson, 1992). *Transfusion, Blood or components*, and *Cardiopulmonary resuscitation* were the most common procedures that nurses reported. *Therapeutic injection of medication, intravenous* was selected as the most frequently performed CPT- coded function. In addition, there are studies dealing with the specialized nursing interventions for ICU patients. These studies focus on providing an oral care program or positioning therapy as a practice program to reduce the VAP rate (Harrigan et al., 2006); bathing process or incontinence management to prevent pressure ulcers (Vollman, 2006); infection

management to reduce catheter associated urinary tract infection (CAUTI) or sepsis (Campbell et al., 2008); a restraint reduction program (Martin, 2002); and medication management (Coons & Seidl, 2007).

The NIC and NOC classifications include core interventions and outcomes frequently used in critical care nursing (Bulechek et al., 2008; Moorhead et al., 2008). These core interventions and outcomes can provide important information for the development of care planning for ICU patients as part of critical care nursing. The NIC and NOC's editors gathered information from clinical specialty organizations related to critical care nursing to identify reliable core interventions and outcomes (Bulechek et al., 2008; Moorhead et al., 2008). These core concepts based on NIC and NOC need clinical evaluation and testing to improve the validity of the core items.

Significance of the Study

This study is significant from three different perspectives. First of all, the study is meaningful because it reveals comprehensive knowledge about nursing care provided to ICU patients. When unique types and patterns of nursing diagnoses, nursing interventions, and nursing sensitive patient outcomes for ICU patient care that have been documented by standardized nursing languages from data warehouse are identified, this information is useful for the allocation of nursing staff and resources, the development of education programs for nurses and students, and the evaluation of nursing practice, all of which help nurses to provide better patient care (Pappas, 2007; Shever et al., 2007). The information also helps establish the core competency requirements for ICU nurses. Moreover, it offers important evidence for determining the cost of nursing practices delivered to ICU patients.

Second, the use of a unified terminology set including NANDA - I diagnoses, NOC outcomes, and NIC interventions can measure the unique contributions of nursing interventions to patient outcomes. When an actual patient database is used to identify the interventions that lead to desired patient outcomes, the information is very reliable and can provide evidence of nurses' decision-making process.

Lastly, this study demonstrates how to extract data from a clinical data set documented by SNLs for nursing research. Studies using large clinical datasets including SNLs are still limited. This study is a precedent for encouraging the use of large clinical datasets from data warehouses.

Summary

Nurses in critical care settings such as intensive care units or cardiovascular care units need advanced skills and a broad knowledge base to care for patients with severe illness and complex problems. However, the value of the nursing practice in critical care settings is often underestimated in the current healthcare system because of the failure to show the evidence of the contribution of nurses to the quality of patient care in ICUs. Therefore, nursing professionals are concerned about how to display this evidence.

A large clinical database including NANDA - I diagnoses, NOC outcomes, and NIC interventions can be useful for identifying nursing care provided to ICU patients. The dataset provides ongoing opportunities to evaluate the impact of nursing interventions on nursing sensitive patient outcomes in ICU settings. However, there are no current nursing studies that delineate this topic. Therefore, this study is meaningful for knowledge development for critical care nursing, supporting decision making processes for critical care nurses, and encouraging the use of large clinical datasets with SNLs. The

information gained from this study will help to establish the competency requirements for nurses working in ICU environments.

CHAPTER II

REVIEW OF THE LITERATURE

The first part of this chapter reviews literature on the development and current status of each standardized nursing terminology: NANDA - I diagnosis, NOC outcome, and NIC intervention. Next, the usefulness of the three nursing terminologies and their actual application in nursing documentation or clinical information systems are reviewed. Moreover, the importance of the three terminologies in nursing effectiveness research is discussed by reviewing several examples of nursing effectiveness research using the classifications. Following this, the literature review discusses critical care nursing in ICU settings, where the population of this study receives care. In this part of the chapter, the current issues and characteristics of critical nursing care are reviewed. Lastly, the factors influencing ICU patient outcomes are identified to clarify confounding variables for the proposed study.

NANDA - I, NOC, and NIC

NANDA - International (NANAD - I)

A nursing diagnosis is defined as "a clinical judgment about an individual, a family, or community responses to actual or potential problems / life processes which provides the basis for definitive therapy toward achievement of outcomes for which a nurse is accountable" (NANDA - I, 2009, p. 367). Therefore, the use of nursing diagnoses makes it possible to consistently document nurses' professional clinical judgments. The North American Nursing Diagnosis Association (NANDA) was established in 1982 as a membership focused on the development of a classification of nursing diagnoses. Because of an increasing interest globally in nursing diagnoses,

NANDA changed its name to NANAD - International (NANDA - I) in 2002 to reflect the growing international membership of the organization.

The current structure for NANDA - I nursing diagnosis has three levels: Domains, Classes, and Nursing diagnostic concepts. There are 210 nursing diagnoses organized into 13 domains. Each nursing diagnosis is composed of label, definition, defining characteristics, and related or risk factors to guide the nurse's diagnosis choice (NANDA - I, 2009).

The NANDA - I diagnostic development is supported by research evidence. Various types of studies such as concept analyses, content validation, construct and criterion-related validation, consensus validation, accuracy studies, and implementation studies have been conducted to support evidence based nursing diagnoses (Lunney, 2009).

Nurses choose nursing diagnoses based on subjective and objective patient data. Then, based on these nursing diagnoses, nurses select nursing interventions to achieve outcomes. Therefore, it is critical to select appropriate nursing diagnoses as they are the basis for selecting nursing interventions that best fit patients' needs and lead to desired patient outcomes. In response to the accuracy issue in the use and interpretation of nursing diagnoses, some studies were conducted to improve nurses' diagnostic accuracy (Lunney, 1998; Lunney, 2003).

Several studies have confirmed that nursing diagnoses are significant predictors of patient outcomes (Halloran & Kiley, 1987; Halloran, Kiley, & England, 1988; Rosenthal et al., 1992; Rosenthal, Halloran, Kiley, & Landefeld, 1995; Welton & Halloran, 1999; Welton & Halloran, 2005). These studies showed that the set of nursing diagnoses selected by nurses can represent the complexity of nursing care provided to patients.

Halloran and Kiley (1987) developed a patient classification system to measure patients' dependency on nursing care during their hospitalization using the quantity of nursing diagnoses. In this study, the patient classification system was significantly associated with hospital length of stay (LOS) and more reliably predicted hospital LOS than the Diagnostic Related Group (DRG) relative cost weight (Halloran & Kiley, 1987; Halloran et al., 1988). Using nursing diagnoses as a Nursing Severity Index, Rosenthal and colleagues (1992) found that the number of nursing diagnoses at admission was significantly related to hospital mortality. Furthermore, they found that the Nursing Severity Index was an independent predictor of hospital charges and LOS (Rosenthal et al., 1995). Similarly, Welton and Halloran (1999, 2005) identified that nursing diagnoses were significantly related to the length of hospital stay, ICU length of stay, total hospital charges, hospital death, and discharge to a nursing home. Moreover, when nursing diagnoses were used with the DRG and the All Payer Refined DRG (APR-DRG) to predict the outcomes, the explanatory power was improved.

Muller-Staub and colleagues (2006) systemically reviewed studies between1982 and 2004 to examine the effects of nursing diagnoses on the quality of the documentation in nursing assessments; the frequency and accuracy of reported diagnoses; and coherence between diagnoses, interventions and outcomes. This systemic review of the literature found that the use of nursing diagnoses improved the quality of documented patient assessments in 14 studies. Moreover, ten studies identified commonly used nursing diagnoses within similar care settings. In eight studies, the researchers identified the linkage among the three terminologies discussed here (Muller-Staub, Lavin, Needham, & van Achterberg, 2006).

Nursing Interventions Classification (NIC)

The Nursing Interventions Classification (NIC) was developed at the University of Iowa College of Nursing as a comprehensive Standardized Nursing Language (SNL) to describe nursing interventions that are provided to patients. Since the first edition of the NIC book published in 1992, the NIC editors have updated the book every 4 years (McCloskey & Bulechek, 1992; McCloskey & Bulechek, 1996; McCloskey & Bulechek, 2000; Dochterman, & Bulechek, 2004; Bulechek, Dochterman & Butcher, 2008). The 5th edition of the NIC book published in 2008 includes 542 NIC interventions under 7 domains and 30 classes (Bulechek et al., 2008). A nursing intervention is defined as "any treatment, based upon clinical judgment and knowledge, that a nurse performs to enhance patient/client outcomes" (Bulechek et al, 2008, p. xxi). An NIC intervention label is composed of a definition, a listing of nursing activities, and background readings.

Some studies using NIC interventions are focused on measuring the intensity of nurses' workload or determining nursing costs (Henry et al., 1997; Iowa intervention project.2001; de Cordova et al., 2010). These studies support that NIC interventions are useful tools to capture nursing activities beyond current CPT coding mechanisms (Iowa intervention project, 2001; Henry et al., 1997). In addition, NIC interventions are independently considered as a measure of nursing workload or intensity (de Cordova et al., 2010; Iowa Intervention Project, 2001).

Nursing interventions vary according to the characteristics of care settings or patient groups. Therefore, the studies to identify core interventions in each specialty or patient group are meaningful because the identified nursing interventions can be used for the development of nursing information systems, staff networks, certification and

licensing examinations, educational curricula, and research and theory construction (McCloskey et al., 1998). As a result, there have been some studies focused on identifying nursing interventions in specialty areas. The early studies used cluster analysis or survey methods (Cavendish, Lunney, Luise, & Richardson, 1999; Haugsdal & Scherb, 2003; McCloskey et al., 1996; O'Connor, Kershaw, & Hameister, 2001). A study using a survey design based on a list of 433 NIC interventions identified core interventions used in 39 nursing specialty areas (McCloskey et al., 1996). In this study, *Pain Management, Documentation, Emotional Support,* and *Discharge Planning* were the most common nursing interventions used in the nursing specialty areas. O'Connor and colleagues used cluster analysis to examine the nursing interventions performed by adult nurse practitioners (ANPs) (O'Connor, Hameister, & Kershaw, 2000; O'Connor et al., 2001). Haugsdal and Scherb (2003) also conducted a study to identify nursing interventions that nurse practitioners perform. The authors identified the 20 most prevalent nursing interventions among NPs' practice. These interventions were similar to the O'Connor et al. (2000)'s study. Focusing on cardiac patients in home care settings, Schneider and Slowik (2009) identified the difference in the frequency of nursing interventions among patients with coronary artery disease, congestive heart failure, and other cardiac diagnoses(Schneider & Slowik, 2009).

With the introduction of EHR recorded by NIC interventions, a few studies using clinical databases identified the patterns of NIC interventions in specified groups of patients. Dochterman and colleagues (2005) examined the nursing interventions used in three elderly patient groups with heart failure, hip fracture procedures, and the risk of falling (Dochterman et al., 2005). Seven common interventions were identified in all

three patient groups: *Cough Enhancement, Diet Staging, Fluid Management, Intravenous (IV) Therapy, Pain Management, Surveillance,* and *Tube Care*. However, the pattern of these interventions differed according to each patient group. Shever and colleagues (2007)'s study using the same database focused more on the unique nursing interventions in each patient group. Moreover, the authors more explicitly described the pattern of nursing interventions over six days of hospitalization. For example, the hip procedure group had the highest frequencies of *Analgesic Administration* and *Pain Management* on day 1 and on day 2. *Cough Enhancement* was more commonly used in the heart failure group (Shever et al., 2007).

Nursing Outcomes Classification (NOC)

With the classification of nursing diagnoses and nursing interventions, there was a need for the classification of nursing-sensitive patient outcomes to be enhanced in order to measure the effectiveness of nursing interventions provided to patients. In response to this need, the first edition of the *Nursing Outcomes Classification* was published in 1997 (Johnson & Maas, 1997). The current edition (4^{th} ed.) of the NOC book contains 385 NOC outcomes (Moorhead et al., 2008). Each NOC outcome is composed of a definition, a set of indicators, measurement scales, and supporting references. The NOC measure is a 5-point Likert-type scale from 1 (lowest) to 5 (highest) (Moorhead et al., 2008). The classification includes outcomes for individuals, caregivers, families, and communities and is organized into 7 domains and 31 classes.

The NOC research team has continued the studies to develop, test, and update NOC outcomes through five phases (Johnson & Maas, 1997; Johnson, Maas, & Moorhead, 2000; Johnson, Maas, & Moorhead, 2000; Moorhead, Johnson, & Maas, 2004;

Moorhead et al., 2008). Focus group reviews by master's-prepared nurse clinicians from various specialties and settings and questionnaire surveys from experts in specialty areas in nursing practice were conducted to establish content analysis and validation of NOC outcomes (Caldwell, Wasson, Anderson, Brighton, & Dixon, 2005; Head, Maas, & Johnson, 2003; Head et al., 2004; Keenan et al., 2003; Keenan et al., 2003). The initial reliability, validity, sensitivity, and usefulness of 190 NOC outcomes were clinically evaluated at 10 field sites (Johnson, Moorhead, Maas, & Reed, 2003; Maas, Johnson, Moorhead, Reed, & Sweeney, 2003; Maas et al., 2002; Moorhead, Johnson, Maas, & Reed, 2003).

In effectiveness research, the change of NOC outcome ratings at certain points can be used to capture the results of nursing interventions. However, actual nursing effectiveness research using NOC outcomes is rare to date. In a pilot study to determine the effect of nursing interventions, Scherb (2002) examined the change in NOC outcome ratings from admission to discharge in three groups of patients with pneumonia, total hip arthroplasty (THA); and total knee arthroplasty (TKA). The author was able to identify the effect of selected nursing interventions through the significant difference generated in the NOC outcome scores. In another study, Scherb, Stevens, and Busman (2007) also examined significant differences in NOC outcomes for a pediatric population admitted to the hospital with the diagnosis of dehydration. Seven of eight outcomes in the standard pediatric dehydration care plan showed significant results. These outcomes were *Nutritional Status, Fluid Balance, Knowledge Status: Illness Care, Child Adaptation to Hospitalization, Electrolyte and Acid/Base Balance, Tissue Integrity: Skin and Mucous Membrane, and Pain Control Behavio*r (Scherb, Stevens, & Busman, 2007). However,

both of these studies failed to examine the unique contribution of each nursing intervention because there was no linkage between nursing interventions and nursing outcomes available due to the structure of the software, and in addition, no information on other relevant factors such as medical treatment and severity of illness were available (Scherb, 2002; Scherb et al., 2007).

The linkage of NANDA - I, NOC and NIC

When NANDA - I, NOC, and NIC are used as a comprehensive set of terms, the unified set of the three terminologies contains the basic components necessary to the nursing process and can be used in all health care settings (Dochterman & Jones, 2003). Moreover, when these three terminologies are used in clinical information systems as source languages, it is possible to make nursing care and its associated activities visible, along with the achievement of nursing sensitive outcomes (Lunney, 2006b). The advantages of NANDA - I, NOC, and NIC in nursing documentation are described in several nursing studies. In Kautz and colleagues' study, the three languages were considered as a clinical vocabulary for clinical reasoning (Kautz et al., 2009; Kautz, Kuiper, Pesut, & Williams, 2006). Researchers evaluated the use of NANDA - I, NOC, and NIC in completing the Outcome-Present State-Test (OPT) model worksheets of clinical reasoning. Even though the results of the study showed that the NNN languages were not used consistently in the process of completing OPT model worksheets, the researchers identified that the samples that used the NNN language consistently did better in completing the clinical reasoning webs and OPT model worksheets (Kautz et al., 2006). In a 2008 study, Kautz and Van Horn found that NANDA - I, NOC, and NIC provided a good framework for the development of evidence-based practice guidelines (Kautz &

Van Horn, 2008). Other researchers have evaluated the quality of nursing documentation before and after incorporating NNN into the nursing documentation (Müller-Staub et al., 2007; Thoroddsen & Ehnfors, 2007). Using pre-post experimental designs, the results of these studies showed that the quality of nursing documentation was significantly improved after using NNN.

Many studies describe the efforts required to implement NANDA - I, NOC, and NIC into nursing documentation in a variety of care settings (Keenan et al., 2008; Lunney, Parker, Fiore, Cavendish, & Pulcini, 2004; Lunney, 2006b; Parris et al., 1999; Rivera & Parris, 2002). A research team consisting of public health nurses developed a charting template based on NANDA - I, NIC, and NOC to standardize and document their practice. The research team identified 65 nursing diagnoses, 128 nursing interventions, and 19 nursing outcomes for public health nursing. In field testing, the identification of nursing diagnoses was increased, and public health nurses preferred this new chart template to the former narrative format (Parris et al., 1999). Using the nursing datasets documented by this nursing chart format, Rivera and Parris (2002) identified the most common nursing diagnoses and interventions used by public health nurses. The analysis of the selected nursing diagnoses and interventions showed that nursing care plans including NANDA - I diagnoses and NIC interventions are useful for documenting the complex practice domain of public health nurses (Rivera & Parris, 2002).

Lunney and colleagues (2004) conducted a quasi-experimental study to compare the effects of using electronic nursing records with and without NANDA - I, NOC, and NIC on nursing outcomes in school settings. The study results showed that the power of the 12 participating school nurses to help children was significantly increased but only

coping strategies among the children's health outcomes were improved. In a follow - up study using secondary data, Lunney (2006b) identified NANDA - I diagnoses, NOC outcomes and NIC interventions used for school nursing. Data abstracted from the EHRs of 103 school children over 6 months contained 44 nursing diagnoses, 93 nursing interventions, and 33 patient outcomes. Four self-concept and self-esteem diagnoses and nursing interventions related to self-esteem were most commonly used in the nursing documentation (Lunney, 2006b).

There are several studies to describe the successful integration of these three languages in a clinical information system (Hendrix, 2009; Klehr, Hafner, Spelz, Steen, & Weaver, 2009). Hendrix (2009) described how to implement NOC outcomes and NIC interventions into a clinical information system. Using NICs and NOCs, a hospital team created pre-determined care plans, which are based on nursing problems using NANDA or medical diagnosis from Interdisciplinary Patient Care Guidelines. Kleher and colleagues (2009) described a process to successfully implement NANDA - I, NOC, and NIC for nursing care plans into a clinical information system, Epic.

Keenan and colleagues (Keenan et al., 2003; Keenan, Falan, Heath, & Treder, 2003; Keenan, Stocker, Barkauskas, Treder, & Heath, 2003; Keenan, Yakel, Tschannen, & Mandeville, 2008; Keenan et al., 2008) conducted studies for the purpose of promoting continuity of care in the "hand-off" of patients among nurses that are good examples to show how to incorporate SNLs into a clinical information system. The authors developed and tested the Hand-on Automated Nursing Data System (HANDS), which is a care planning system including NANDA - I diagnoses, NOC outcomes, and NIC interventions. The purpose of HANDS is to standardize the plan-of-care documentation and process for

supporting interdisciplinary decision making (Keenan et al., 2008). Their studies showed that NANDA, NOC, and NIC can be used as data elements of HANDS to transform nursing practice (Keenan et al., 2008).

Some implementation studies have pointed out the importance of staff education for the three languages (Klehr et al., 2009; Lunney, 2006a). Most nurses in their hospitals had never learned about NANDA - I, NOC, and NIC. The researchers addressed that this knowledge deficit of standardized nursing terminologies could lead to incorrect use of the terminologies. Therefore, nursing education on how these three terminologies should be used in an EHR is needed to achieve higher consistency among uses of terms in different settings (Lunney, 2006a).

Nursing Effectiveness Research using NANDA - I, NOC, and NIC

Effectiveness research is conducted to identify the effect of interventions or treatments on patient outcomes in typical practical care settings (Hubbard et al., 2002; Titler et al., 2008). Effectiveness research aims to provide information for better decision-making by patients, healthcare providers, and health policy makers (Jefford, Stockler, & Tattersall, 2003). In other words, identifying which nursing interventions work best for specific diagnoses and in turn lead to positive patient outcomes can assist nurses to make better clinical decisions (Titler, Dochterman, & Reed, 2004). An important requirement of effectiveness research in nursing is the databases that contain many cases, come from multiple sites, and have data elements in standardized format (Ozbolt, 1992). Therefore, standardized nursing languages are useful for collecting information generated about nursing care and can be used by nurses as the basis for nursing effectiveness research (Maas & Delaney, 2004). In particular, the introduction of

Electronic Health Records (EHRs) makes it easier to collect nursing care data including nursing diagnoses, interventions, or outcomes for various purposes (Lunney, 2006b). In a few recent studies, NIC interventions were used to describe the contribution of nursing interventions to patient outcomes (Shever et al., 2008; Titler et al., 2006; Titler et al., 2007; Titler et al., 2008). Titler and colleagues (2006)' research provides examples of nursing effectiveness studies that used an electronic clinical database incorporating SNLs. The researchers examined the effect of nursing interventions and other factors on discharge disposition of elderly patients hospitalized for a fractured hip or hip procedure. In this study, nine nursing interventions defined by NICs were significantly related to discharge to home. The NIC interventions were *Bed Rest Care, Postoperative Care, Diet Staging,* and *Bathing*, and were considered routine admission and recovery patterns. These NIC interventions had a positive influence on discharge status to home. In contrast, *Infection Protection, Teaching, Fall Prevention, Thrombus Precautions, and Exercise Therapy*, which indicates a more chronic complicated treatment, were negatively associated with discharge status to home (Titler et al., 2006).

In a study to capture a specified nursing intervention using NIC, Shever and colleagues (2008) examined the effect of *Surveillance*, which is an important nursing intervention for *Fall Prevention*, on hospital cost for hospitalized elderly adults at risk for falling. Propensity score analysis calculated by potential treatment confounders and generalized estimating equation (GEE) analysis were used for the study. The results of this study showed the effect of high surveillance delivery on hospital cost compared to low surveillance delivery by nurses. Even though the effect of high surveillance delivery on hospital cost was higher ($191 per hospitalization) than the effect of low surveillance

delivery, patients receiving high surveillance had fewer fall events. Shever et al. (2008) explained this as cost saving because it avoids the cost of caring for patients with falls.

Another study presented the use of NIC interventions in nursing effectiveness research and discussed the issue of measuring the dose of nursing interventions (Reed et al., 2007). As a method of calculating the dose of nursing intervention, the authors suggested an average intervention use rate per day over the entire hospitalization (the number of times that a nursing intervention was delivered during the entire hospitalization / length of stay). The study showed that the intervention use rate defined in this manner was a useful measure to compare effects among nursing interventions on outcomes and to capture the relationship between nursing interventions and outcomes (Reed et al., 2007).

Critical Care Nursing

Since the first ICU appeared in the 1950s, even though the number of acute care hospital beds has decreased, the number of critical care beds has been gradually increasing (Halpern & Pastores, 2010). In particular, with the increase of the aging population, ICU use with Medicare hospitalizations has increased rapidly (Cooper & Linde-Zwirble, 2004; Milbrandt et al., 2008). Several studies using large clinical datasets explored the current trend and characteristics of critical care beds from the perspective of medicine (Cooper & Linde-Zwirble, 2004; Halpern & Pastores, 2010; Milbrandt et al., 2008). A retrospective study using data retrieved from the Hospital Cost Report Information System (HCRIS, Center for Medicare and Medicaid Services, Baltimore, Maryland) between 2000 and 2005 provided information about the use and costs of critical care beds in the U.S. This study has shown that the number of critical care beds

has slightly increased by 6.5% (more than 4 million patients per year). Thus, the three ICU categories (intensive care, premature/neonatal, and coronary care) occupied 90% of critical care beds (Halpern & Pastores, 2010).

Other studies analyzing data from the Medicare Inpatient Prospective Payment System (IPPS) showed that ICU care consisted of about 30% of all Medicare hospitalizations (Cooper & Linde-Zwirble, 2004; Milbrandt et al., 2008). However, the costs of ICU patients often exceeded the average cost depending on DRG-based payment. As a result, ICU patients receiving more expensive patient care are often reimbursed less in the current IPPS system. In particular, only 83% of costs were paid by Medicare on behalf of ICU patients in 2000 (Cooper & Linde-Zwirble, 2004).

ICUs currently consume a large part of the health care budget, and staff nurses are considered the biggest single expense (West et al., 2009). However, the variations in nursing resource consumption in critical care settings are disregarded in current DRG reimbursements and the per diem hospital charging system (Sullivan et al., 1988). Nevertheless, little research focused on critical care nursing has been conducted to date (Kirchhoff & Dahl, 2006). A few studies have dealt with the nursing shortage in ICUs (Buerhaus, Staiger, & Auerbach, 2000; Stone et al., 2009). The shortages of registered nurses in ICU settings are higher than the shortages of RNs in general units (Buerhaus et al., 2000). These shortages are often related to the nurses' work environment. Stone et al. (2009) identified the factors related to the intention to leave of 2,323 ICU nurses from 66 hospitals. In this study, 52 % of nurses having the intention to leave chose poor working conditions (e.g., wages or staffing policy) as the reason. Retirement or positive career growth were other reasons for the intention to leave (Stone et al., 2009)

The Identification of Nursing Diagnoses, Nursing Inventions and Nursing Outcomes in ICU Settings

Nurses working in critical care settings such as ICUs need specialized knowledge and skills to provide appropriate care to critically ill patients (Stone & Gershon, 2009). Such skills include advanced pathophysiology, astute assessment and judgment, critical care nursing skills, the ability to accurately define and change priorities rapidly, good communication and team work skills, and the ability to work in stressful environments (Swinny, 2010).

In the process of developing outcome standards for critical care nursing, the American Association of Critical-Care Nurses (AACN) held a consensus conference to determine nursing diagnoses for critical care nursing (Kuhn, 1991). Using Likert-type scaling (for rating frequency and rating importance) and Magnitude estimation scaling, a group of critical care experts classified nursing diagnoses for critical care nursing using five categories: High frequency and high priority, low frequency and high priority, high frequency and low priority, borderline, and low frequency and low priority. All twelve nursing diagnoses classified as high frequency, high priority in critical care nursing were physiological nursing diagnoses. The nursing diagnoses were *Altered Fluid Volume/Dynamics, Impaired Gas Exchange, Altered Tissue Perfusion, Potential for Infection, Altered Nutrition, Impaired Skin Integrity, Altered Comfort, Activity Intolerance, Sensory/Perceptual Alteration,* and *Impaired Physical Mobility* (Kuhn, 1991). Wieseke and colleagues (1994) selected three common nursing diagnoses for adult ICU patient care to identify critical care nurses' perceptions of nursing diagnoses and to validate the defining characteristics of the nursing diagnoses. Those diagnoses were

Impaired Skin Integrity, *Sleep Pattern Disturbance*, and *Activity Intolerance* (Wieseke et al., 1994).

In an initial effort to identify nursing practice in critical care settings, Griffith and Robinson (1992) surveyed the degree to which critical care nurses performed interventions in the current procedural terminology (CPT)-coded services. The questionnaire included 100 CPT codes selected by a panel of four critical care nurses. In the questionnaire, 28 CPT codes were performed by more than 70% of the respondent group. 'Blood and blood component transfusion' and 'Cardiopulmonary resuscitation' were the CPT codes selected most frequently by the group. Moreover, the amount of supervision that the nurse received while performing the CPT codes was significantly different depending on the education level of the nurses. Diploma-prepared nurses had significantly more supervision than nurses with a bachelor's or master degree (Griffith & Robinson, 1992).

There are many studies dealing with the specialized nursing interventions for ICU patients. The studies are oral care programs or positioning therapy as a practice program to reduce the ventilators-associated pneumonia (VAP) rate (Harrigan et al., 2006); bathing process or incontinence management to prevent pressure ulcers (Vollman, 2006); infection management to reduce catheter associated urinary infection (CAUTI) or sepsis (Campbell et al., 2008); Restraint reduction program (Martin, 2002); and Medication management (Coons & Seidl, 2007). In particular, respiratory care and ventilator management were described as key aspects of critical care nursing (Leslie, 2010). Tilter and colleagues (1996) surveyed critical care nurses to identify which NIC interventions were being used in their practice. The domains of most prevalent NIC interventions were

the Physiological: Complex and the Physiological: Basic domains. *Vital Signs Monitoring, Positioning, Medication Administration: Parenteral,* and *Intravenous Therapy* were highly used NIC interventions (Titler et al., 1996).

Many studies about the outcomes of critical care nursing have focused on patient safety and quality of care (Siegele, 2009; Vollman, 2006; West et al., 2009) ICU mortality, length of stay (Pronovost et al., 1999; Shortell et al., 1994), and adverse event rate such as the rate of VAP and pressure ulcers are typical types of outcomes to measure the quality of critical care. Unit based pressure ulcer incident rate, VAP rate, and bloodstream infection rates are referred to as nursing sensitive outcomes in ICU patient care (NQF, 2004; Whitman et al., 2002). A nested case-control study in a SICU setting explored the influence of the composition of the nursing staff on bloodstream infection rate (Robert et al., 2000). Using blood stream infection related to a central venous catheter (CVC) as the outcomes, Fridkin and colleagues (1996) found that the nurse-patient ratio had a significant influence on the probability of infection.

NIC and NOC books also suggest core interventions and outcomes frequently used in critical care nursing (Bulechek et al., 2008; Moorhead et al., 2008). These core interventions and outcomes can provide important information for the development of care planning for ICU patients as part of critical care nursing. The editors of NIC and NOC gathered information from clinical specialty organizations related to critical care nursing to indentify reliable core interventions and outcomes (Bulechek et al., 2008; Moorhead et al., 2008). These core items, which were identified by experts' opinions in the organizations using survey methods, still need clinical evaluation and testing to improve the validity of the core items (Table 2.1).

Factors Influencing ICU Patient Outcomes

There are several important factors that influence patient outcomes in ICU units. Age, medical diagnoses, comorbid medical conditions, ICU length of stay, and nurse staffing are variables that can determine nursing practice.

Age

As the ICU population is aging, many studies have been dealing with the impact of advanced age on patient outcomes. Most of the studies identified that advanced age had a negative influence on patient outcomes such as ICU length of stay and hospital mortality (Boumendil et al., 2004; de Rooij, Abu-Hanna, Levi, & de Jonge, 2005; Vosylius, Sipylaite, & Ivaskevicius, 2005).

Medical Diagnoses

Medical diagnoses, which are usually classified by the International Classification of Disease (ICD) codes, are important factors influencing patient outcomes during hospitalization (Cohen & Lambrinos, 1995; de Rooij et al., 2005). For example, ICU patients with infectious diseases such as sepsis at admission had higher mortality than the patients with gastrointestinal diseases (Cohen & Lambrinos, 1995).

Comorbid Medical Conditions

Comorbid medical conditions are defined as the medical diagnoses or diseases that a patient has before an admission, not related to the main reason for the hospitalization. Even though these comorbidities do not have a significant influence on resources or mortality during hospital stay, important comorbidities of patients increase the use of resources and decrease patient outcomes (Elixhauser, Steiner, Harris, & Coffey, 1998). In particular, most elderly patients admitted to the ICU have comorbidities (de Rooij et al., 2005). Several studies show that these comorbid conditions influence

different types of patient outcomes (e.g. hospital mortality, length of stay, and ICU readmission) (Ho et al., 2009; Norena, Wong, Thompson, Keenan, & Dodek, 2006).

ICU Length of Stay

Prolonged ICU length of stay has been perceived as an indicator of poor prognoses such as a significant decline in long-term survival (Bashour et al., 2000; Soares, Salluh, Torres, Leal, & Spector, 2008). Soares and colleagues (2008) evaluated the outcomes of cancer patients with prolonged ICU length of stay (ICU stay ≥21 days). These patients were at an increased risk of severe complication. In particular, 90% of the patients had acquired nosocominal infections during their admission (Soares et al., 2008).

Nurse Staffing

In the current fixed charge system based on the type of room, hospital administrators often reduce the level of ICU nurse staffing as a method of cost reduction. With this concern related to nurse staffing, research about the impact of nursing resources on the ICU patient is important to provide evidence about the appropriate levels of nurse staffing in ICU settings. In response to this concern, there are several literature studies to examine the relationship between nurse staffing and patient outcomes, such as ICU/hospital length of stay, mortality, nosocominal infections (Amaravadi et al., 2000; Dang et al., 2002; Fridkin et al., 1996; Hickey, Gauvreau, Connor, Sporing, & Jenkins, 2010; Hugonnet et al., 2007; Pronovost et al., 1999; Robert et al., 2000; West et al., 2009). These studies showed that fewer nurses on duty increased ICU patients' hospital length of stay (LOS), complications after surgery, or the rates of hospital acquired infections (Table 2.3) (Amaravadi et al., 2000; Dang et al., 2002; Fridkin et al., 1996; Hickey et al., 2010; Hugonnet et al., 2007; Pronovost et al., 1999; Robert et al., 2000).

Summary

There have been numerous studies dealing with NANDA - I diagnoses, NOC outcomes, and NIC interventions. The early studies were focused on the development process or the establishment of reliability and validity of the three languages using a variety of research methodologies. Moreover, researchers identified the usefulness of these languages in describing nursing practice. Each research team continues to evaluate, update, and refine the nursing terminology.

With the appearance of EHR, current studies have demonstrated how to incorporate NANDA - I, NOC, and NIC into clinical information systems. Furthermore, the several studies using clinical datasets including these three languages have been conducted to identify the patterns of nursing practice and the effect of the nursing interventions on the patient outcomes.

Revealing the contribution of nursing care to ICU patient outcomes is one of most important concerns of nursing professionals. Through the identification of the nursing diagnoses, nursing interventions, and nursing-sensitive patient outcomes related to critical care nursing, nurses will be able to describe, to explain, and to predict the types of care they provide to ICU patients. However, much of the research on critical care nursing focuses on one or two specified interventions or the effect of the interventions, and little is known about the identification of routine common diagnoses, interventions and outcomes used in critical care settings. A few survey studies have been conducted to identify nursing interventions and outcomes for ICU patient care. No study for identifying nursing diagnoses in ICU settings exists.

Table 2. 1 Core Interventions and Outcomes for Critical Care Nursing

NIC Interventions (Bulechek et al., 2008, p. 813)	NOC Outcomes (Moorhead et al., 2008, p. 848)
Acid-Base Monitoring	Acute Confusion Level
Airway Management	Allergic Response: Systemic
Airway Suctioning	Anxiety Level
Analgesic Administration	Blood Loss Severity
Anxiety Reduction	Burn Healing
Artificial Airway Management	Burn Recovery
Cardiac Care: Acute	Cardiac Pump Effectiveness
Cardiac Precautions	Cardiopulmonary Status
Caregiver Support	Client Satisfaction: Pain Management
Circulatory Care: Mechanical Assist Device	Client Satisfaction: Physical Care
Code Management	Client Satisfaction: Technical Aspects of Care
Decision-Making Support	Cognitive Orientation
Defibrillator Management: External	Comfort Status
Defibrillator Management: Internal	Comfortable Death
Delegation	Dignified Life Closure
Discharge Planning	Discomfort Level
Documentation	Electrolyte & Acid/Base Balance
Electrolyte Management	Family Coping
Electrolyte Monitoring	Family Participation in Profession Care
Emotional Support	Family Support During Treatment
Family Involvement Promotion	Fear Level
Family Presence Facilitation	Fear Level: Child
Fluid/Electrolyte Management	Fluid Overload Severity
Fluid Management	Immobility Consequences: Physiological
Fluid Monitoring	Immobility Consequences: Psycho-Cognitive
Hemodynamic Regulation	Kidney Function
Intracranial Pressure (ICP) Monitoring	Mechanical Ventilation Response: Adult
Intravenous (IV) Therapy	Mechanical Ventilation Weaning Response: Adult
Invasive Hemodynamic Monitoring	Medication Response
Mechanical Ventilation Management: Invasive	Nausea & Vomiting Control
Mechanical Ventilation Management	Nausea & Vomiting: Disruptive Effects
Mechanical Ventilation Weaning	Nausea & Vomiting Severity
Medication Administration	Neurological Status: Autonomic
Medication Administration: Intravenous (IV)	Neurological Status: Consciousness
Multidisciplinary Care Conference	Neurological Status: Cranial Sensory/ Motor Function
Nausea Management	Neurological Status: Peripheral
Neurological Monitoring	
Oxygen Therapy	

Table 2.1 Continued

Pacemaker Management: Permanent	Neurological Status: Spinal Sensory/ Motor Function
Pacemaker Management: Temporary	Nutritional Status
Pain Management	Nutritional Status: Biochemical Measures
Patient Rights Protection	Pain Control
Physician Support	Pain Level
Positioning	Pain: Adverse Psychological Response
Respiratory Monitoring	Pain: Disruptive Effects
Sedation Management	Psychological Adjustment: Life Change
Shock Management	Respiratory Status
Teaching: Procedure/ Treatment	Respiratory Status: Airway Patency
Technology Management	Risk Control: Cardiovascular Health
Temperature Regulation	Stress Level
Thrombolytic Therapy Management	Swallowing Status
Transport: Interfacility	Symptom Severity
Transport: Intrafacility	Tissue Perfusion: Cardiac
Visitation Facilitation	Tissue Perfusion: Cellular
Vital Signs Monitoring	Tissue Perfusion: Cerebral
Vomiting Management	Tissue Perfusion: Pulmonary
	Urinary Elimination
	Vital Signs
	Wound Healing: Primary Infection
	Wound Healing: Secondary Infection

Table 2. 2 The Relationship between Nursing Staffing and Patient Outcomes

Reference	Nurse staffing	Outcomes	The relationship with patient outcomes
Fridkin et al. (1996)	Average monthly SICU patient-to-nurse ratio	Central venous catheter - Bloodstream Infection (CVC-BSI) Length of SICU stay Mortality	• The occurrence of at least one CVC -BSI was strongly associated with a higher patient-to-nurse ratio.
Pronovost et al. (1999)	Nurse-to-patient ratio during the day and evening - Less than or equal to 1:2 - More (> 1:2)	Hospital Mortality Hospital length of stay (LOS) ICU LOS Specific postoperative complications	• A low nurse-to-patient ratio was associated with increase in ICU LOS and increased risk of developing postoperative pulmonary complications in patients with abdominal aortic surgery. • No association between nurse to patient ration and hospital mortality
Amarvadi et al.(2000)	A night-time nurse-to-patient ration (NNPR) in the ICU - One nurse caring for one or two patients (>1:2) - One nurse caring for three or more patients (<1:2)	Hospital LOS Total hospital cost Specific postoperative complication	• Pneumonia (Odds Ratio (OR) = 2.4, Confidence interval (CI) =1.2-4.7), Re-intubation (OR = 2.6, CI=1.4-4.5), and Septicemia (OR = 3.6, CI=1.1-412.5) were associated a NNPR < 1:2. • 39% increase in in-hospital LOS for patients with a NNPR <1:2 compared to patient with a NNPR >1:2 • 32% increase in direct hospital cost for patients with an NNPR <1:2 • No association between nurse to patient ration and hospital mortality
Robert et al. (2000)	Regular staff vs. Pool staff Nursing skill mix	BSI	• Patients with BSI had significantly lower regular nurse to patient and higher pool nurse to patient ratio for the 3days before BSI • Admission during a period of higher pool-nurse-to-patient ratio increased the risk of BSI (OR =3.8, CI=1.2-8.0).

Table 2.2 Continued

Dang et al.(2002)	Three types of nurse staffing : - Low- intensity (≥1:3 on the day and night shift) - Medium -intensity (≥1:3 on either the day or night shift) - High-intensity (≤1:2 on the day and night shit)	Medical Complications of abdominal aortic surgery captured by ICD-9-CM codes : - Cardiac - Respiratory - Others	• Decreased nurse staffing was significantly associated with increased risk of cardiac, respiratory, and other complications in patients with abdominal aortic surgery. - Respiratory complication(low vs. high) : OR = 2.33, CI = 1.50-3.60 - Cardiac complication (medium vs. high) : OR, = 1.78, CI=1.16-2.72 - Other complications(medium vs. high): OR=1.74, CI=1.15-2.63
Hugonnet et al. (2007)	Nurse-to-patient ratio in MICU	ICU- acquired infection rates	• A high nurse to patient ratio was associated with a decreased risk for late-onset VAP (Hazard ratio = 0.42, CI= 0.18-0.99).
Hickey et al.(2010)	Nursing Work Hours Per Patient Day(WHPPD) Nursing skill mix	Institution cardiac surgery volume - the number of congenital heart surgical procedures at each hospital Risk adjustment for Mortality	• Higher nursing worked hours was significantly associated with higher volume (r_s= 0.39. *P*=.027). • Hospital volume was significantly associated with risk adjusted mortality (OR = 0.93, CI=0.90-0.96).

CHAPTER III

METHODOLOGY

This study was a retrospective and descriptive study using large clinical data sets. Data were extracted from elements of an electronic health information system in a large tertiary-care hospital. The electronic health information system of this hospital has a nursing component that contains NANDA - I, NOC, and NIC. This chapter describes settings and samples, variables and measures, the data collection process, and the data analysis for this study.

Setting and Samples

Setting

The hospital selected for this study is a 680-bed academic medical center in the Midwest with three adult intensive care units: the Cardiovascular Intensive Care Unit (CVICU, 12 beds), the Surgical Intensive Care Unit (SICU, 34 beds in 4 bays), and the Medical Intensive Care Unit (MICU, 14 beds). The nursing staff consists of over 1,671 registered nurses. In 2004, the Department of Nursing Services and Patient Care at this hospital received Magnet designation for excellence in nursing service from the American Nurses Credentialing Association. It was the first hospital in the state to receive the Magnet designation. This hospital has been a test site for the clinical testing of NIC since the development of NIC (Daly, Button, Prophet, Clarke, & Androwich, 1997; Prophet, Dorr, Gibbs, & Porcella, 1997).

Epic

The hospital launched a new integrated health information system, Epic, for multi-disciplinary health care providers in February of 2009 for the ICUs. Epic is one of the nationally certificated electronic health record venders (Klehr et al., 2009). The use of the Epic system allows healthcare providers to enter patient information in one central location at the point of care. This integrated information system includes not only medical history and clinical notes from physicians, but also all updates from other departments such as Pharmacy, Radiology, and Laboratory. As a result, the system provides hospital staff with useful tools for computerized tracking of patient records, nursing documentation, care planning, order entry, medication administration, and data downloads from biomedical devices. In particular, for nursing documentation, the system has pre-built care plan templates to support clinical decisions, and NANDA - I diagnoses, NOC outcomes, and NIC interventions are used as standardized source terminologies in nursing care plans.

A “crosswalk” from the legacy system to Epic was provided during training for Epic care planning. The nursing staff of the hospital were already familiar with NANDA - I diagnoses and NIC interventions because an INFORMM system, before Epic, used NANDA - I diagnoses for patient problems and NIC interventions for interventions. However, the INFORMM system used goal statements instead of NOC outcomes. Therefore, education for Epic Care Planning using NOC outcomes was provided to nursing staff during Epic training (Refer to Appendix A. Handout for Epic care planning using NOC).

The hospital policy and procedure for care plans describes that registered nurses are responsible for establishing and updating nursing care plans (Policy and Procedure Manual N-09.060, Refer to Appendix B). The nursing care plans should be initiated 24 hours after hospital admission.

Sample

The study sample consisted of administrative data (patient demographics and nursing unit characteristics) and nursing documentation, including NANDA - I, NOC, and NIC, of all patients admitted to three adult intensive care units of the hospital for a period of two months. Inclusion criteria for subjects in this study were: 1) Patients admitted to the CVICU, the SICU, and the MICU between March 25, 2010 and May 31, 2010, and 2) Patients 18 years old and older. The study focused on the care provided by nurses while they were patients in these units and did not follow patients when patients were transferred to outside of the ICU environment. Therefore, 1) Patients who didn't have nursing care plans during ICU stay, 2) Patients whose NOC outcomes were not rated during ICU stay, and 3) Patients who moved from one type of ICU to another ICU in the hospital were excluded from the study.

Variables and Measures

Conceptual Model

The use of NANDA - I, NOC, and NIC can describes the nursing process which nurses use to deliver care to patients. As the key components of the nursing process (Figure 1), NANDA - I, NOC, and NIC represent nursing diagnoses, nursing sensitive patient outcomes, and nursing interventions. NANDA - I diagnoses describe current patient risks/problems or clinical situations nurses treat. NOC outcomes specify

outcomes as a goal to be achieved and are used to evaluate the appropriateness of patient care interventions. NIC interventions are used to specify interventions based on the characteristics of the nursing diagnosis and desired patient outcomes. Therefore, the identification of NANDA - I diagnoses, NOC outcomes, and NIC interventions helps to delineate nursing care provided to patients. Moreover, when patient outcomes are linked to interventions that are driven by assessments, the effectiveness of the interventions on the outcomes can be evaluated.

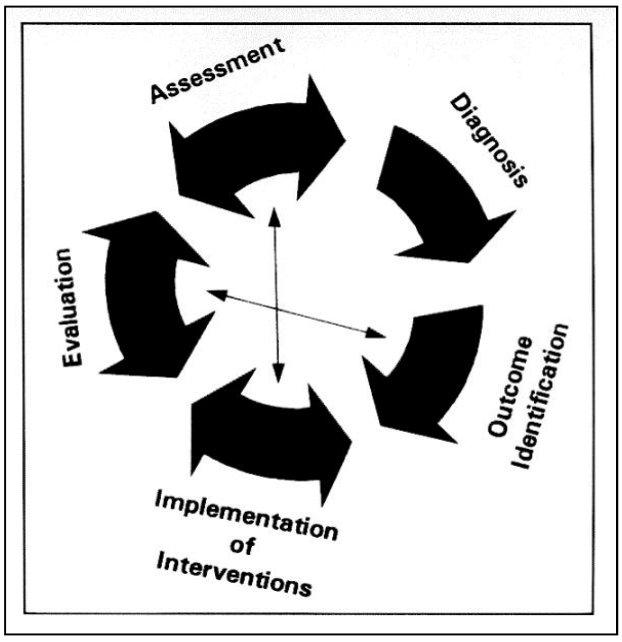


Figure 2.1 Nursing Process

Source: Patient Outcome: The Link Between Nursing Diagnoses and Interventions. *Journal of Nursing Administration, 26*(11), 29-35

Nursing Outcomes

Nursing Outcomes Classification (NOC): A nursing outcome is defined as "an individual, family, or community sate, behavior, or perception that is measured along a continuum in response to nursing intervention (s)" (Moorhead et al., 2008, p. 30). Each NOC outcome is composed of a label, a set of indicators, and a measurement scale. The NOC measurement focuses on a 5-point Likert-type scale from 1 (least desirable) to 5 (most desirable) (Moorhead et al., 2008). In addition, for research questions 2, 7, and 8, the change in the NOC outcome scores was calculated as the difference between a baseline rating of the outcome and a post intervention rating of the outcome or the outcome ratings at discharge from the ICUs (the last outcome score rated). This score was split into three categories: Improved (rating increased), Declined (rating decreased), and No change (rating stayed the same).

Speaking strictly, NOC outcome scales are not ordinal. Contrasting with a unit's increase in blood pressure, a unit increase between NOC outcome scores might be different among patients because the score is a conceptual scale measured by nurses. However, the increase in NOC outcome scores means the improvement of the patient condition. Therefore, the changes of NOC outcome scores are collapsed into "Improved" and "Declined."

Nursing Interventions

Nursing Interventions Classification (NIC): NIC is a comprehensive, standardized classification of interventions that nurses perform. A nursing intervention from the perspective of NIC is defined as "any treatment, based upon clinical judgment and knowledge, that a nurse performs to enhance patient/client outcomes" (Bulechek et al.,

2008, p. xxi). NIC interventions are organized into a taxonomy with 30 classes and 542 interventions under 7 domains that represent the physiological and psychosocial aspects of patient care. It is a categorization of direct and indirect care activities performed by nurses (Bulechek, et al., 2008). For this study, a NIC intervention was first created as a dichotomous variable that has 'Yes' or 'No' whether or not the intervention was used.

Nursing Diagnoses

NANDA - International (NANDA - I): Nursing diagnosis is defined as "a clinical judgment about individual, family, or community responses to actual or potential health problems/life processes" (NANDA - I, 2009). The NANDA - I diagnosis contains the label, the definition of the diagnosis, the defining characteristics (signs and symptoms), and the related factors (causative or associated). A NANDA - I diagnosis was also created as a dichotomous variable that has 'Yes' or 'No' whether or not the diagnosis was used. The number of NANDA - I diagnoses per patient was also calculated for further analysis.

Patient Characteristics

Age at admission stands for the number of years a patient has lived after being born as a continuous variable. **Gender** is divided into female and male as a dichotomous variable. **ICU Length of Stay (LOS)** measures the duration of a single episode of hospitalization in an ICU. This variable was calculated by subtracting day of ICU admission from day of ICU discharge as a continuous variable (Refer to Table 3.1).

Clinical Conditions

Clinical conditions include the patient's primary diagnosis and comorbid medical conditions measured during hospitalization. **Primary medical diagnosis** is the main

condition treated or investigated by physicians at admission. The primary medical diagnosis was originally identified by the International Classification of Disease, 9th Revision (Clinical Modification; ICD-9-CM) codes. To make it easier to statistically analyze and report, the large number of ICD-9-CM codes was reduced by the Clinical Classification Software (CCS). CCS, which was developed at the Agency for Healthcare Research and Quality (AHRQ), is a method to categorize patient diagnoses and procedures into a manageable number of clinically meaningful groups (Elixhauser, Steiner, and Palmer, 2011).

Comorbid medical conditions were measured using a comprehensive set of 30 comorbidities developed by Elixhauser et al (1998). These comorbid medical conditions are defined as the clinical conditions that a patient has before an admission, not related to the main reason for the hospitalization (Elixhauser et al., 1998). Medical diagnoses extracted from patient discharge summaries documented by physicians were used to calculate a score for comorbid medical conditions. A list of all 30 comorbid medical conditions has been attached in Appendix C. If a patient has a disease, it would be '1'. The final scores were calculated as the sum of comorbid conditions. As a continuous variable, the scores ranged from 0 to 30.

Nursing Characteristics

The type of ICU settings were classified into three categories based on the characteristics of the ICU settings which patients were admitted to during the 2 months of the study (1= SICU, 2=MICU, and 3=CVICU).

Nursing staff to patient ratio is the average number of patients assigned to a nursing staff member. To calculate this number, total number of patients for a one hour

time period was divided by the number of nursing staff for the same hour. The rate was categorized into three groups: less than 1:1, greater than or equal to 1:1 and less than 1:1.5, and greater than or equal to 1:1.5. S**kill mix of nursing caregivers** is defined as the proportion of RNs to other personnel (LPNs, NAs) delivering patient care. It was calculated as the average number of registered nurses (RNs) divided by the average number of all nursing direct caregivers (RN, LPN, and Others) during a specific period of time as a continuous variable (Titler et al., 2006).

Data Collection and Management

The data of this study were collected through two different processes:

Patient characteristics (age, gender, medical diagnoses, and ICU length of stay) and nursing characteristics (the number of RNs, LPNs or Other staff and the number of patients in each ICU per hour) were from the data warehouses of the hospital. The data extracted by the Health Care Information System (HCIS) staff were delivered as an excel file for patient characteristics and a text file for nursing characteristics. The data for nursing unit characteristics extracted from the nursing staff database provided information about the total number of patients and nursing staff (RN, LPN, and others), and the movement of patients (Transfer in, transfer out, and discharge to and from ICU) per hour according to ICU units.

Individuals' nursing care plans including NANDA - I, NOC, and NIC were manually collected by a PI from individual electronic health records (Epic). Before extracting nursing care plans from Epic, the PI had two hours training for a staff member in the department of Nursing Informatics about how to access the Epic system, where nurses document nursing care plans, and how to extract the nursing care plans. As a

template for data collection, an Excel sheet including all variables related to the nursing care plan was constructed. The PI reviewed individual nursing care plans' summary in Epic for each ICU patient in administrative data. Nursing care plans over ICU stay were moved into the Excel sheet using simply 'copy' and 'paste'.

Data Analysis

Statistical Package of Social Study (SPSS), version 19.0 (SPSS Inc, Chicago, Illinois) was used for data analysis. Data analysis for each research question is described below:

Research Questions

1. What NANDA –I diagnoses are most frequently selected by nurses for ICU patient care?

   Frequency analysis was conducted to identify which NANDA- I diagnoses are selected most frequently for the ICU patients.

2. What NOC outcomes are most frequently selected by nurses for ICU patient care? What is the change of the selected NOC outcome scores for ICU stay?

   Frequency analysis was conducted to identify which NOC outcomes were selected most frequently for these patients. The mean and standard deviation score were indentified for the change of the NOC outcome's score over ICU stay. To calculate the average hours per NOC outcome score, ICU length of study (hours) was divided by the number of the NOC outcome scores rated during ICU stay.

3. What types of NIC interventions are used most frequently over the ICU stay?

   Frequency analysis was conducted to identify which NIC interventions were selected most frequently in the nursing care plans.

4. What linkages of NANDA - I, NOC and NIC are selected most frequently by nurses for ICU patient care?

   Frequency analysis was conducted to identify the most prevalent linkages of NANDA –I diagnoses, NOC outcomes and NIC interventions.

5. How do the interventions and outcomes selected by nurses compare with core interventions and outcomes validated by experts?

   The label names of NIC interventions and NOC outcomes in both lists were compared. The identical label names of NIC interventions and NOC outcomes were examined by a review process. Particularly, the number and percentage of the NOC outcomes, which were the ten most commonly used in nursing care plans but were not in core intervention or outcomes for critical care nursing, were examined. Thus, the NIC interventions and NOC outcomes which are not matched with core concepts suggested by NIC and NOC books (Bulechek et al., 2008; Moorhead et al., 2008) were evaluated for appropriateness in ICU patient care.

6. What are the differences and similarities between how NANDA - I, NOC and NIC are used in the three different ICU settings?

   The ten most prevalent NANDA - Is, NOCs and NICs in each ICU were identified by frequency analysis. The unique NANDA - I, NOC, and NIC were identified by a review process. Chi-square test was used to verify the statistical significance in proportion of each terminology among the three units.

7. What patient characteristics (age, gender, and ICU length of stay), clinical conditions (primary diagnosis and comorbid diseases), and nursing characteristics

(ICU type, the number of NANAD-I diagnoses, nursing staff to patient ratio, and skill mix of nursing caregivers) are associated with the change of frequently selected NOC outcome scores?

For this research question, the 5 most commonly used in ICU nursing care plans, which were identified in research question 2, were used: *Pain Level* , *Respiratory Status: Gas Exchange*, *Respiratory Status: Airway Patency*, *Infection Severity*, and *Tissue Integrity: Skin and Mucous Membranes*. In order to examine the association between the change of the NOC outcome scores and study variables (the patient characteristics, clinical conditions, and nursing characteristics variables), were examined to determine if the variables were significantly related to the change of the selected NOC outcome scores. A one-way analysis of variance (ANOVA) for continuous variables and a chi-square test for categorical variables was used to evaluate the association between the change of NOC outcome scores and each variable.

8. What are the unique contributions of patient characteristics, clinical conditions, and nursing characteristics on the change of the selected NOC outcomes scores?

Multinomial logistic regression was conducted to determine the effect of the study variables on the change of NOC outcome scores. A multinomial logistic regression is used to analyze predictors for unordered outcome categories. In this study, the change of NOC outcome scores, which were grouped into three categories, was used as a dependent variable. This multinomial logistic regression is more intuitive than multiway contingency table and loglinear analyses because there are several study variables being examined with a dependent variable

(Tabatchnic & Fidell, 2007). Study variables yielding $P < .30$ in research question 7 were entered into multinomial logistic regression models for each NOC outcome to construct a stronger model.

Human Subject Approval

This study was approved by the University of Iowa's Institutional Review Board (IRB). In particular, due to the change of data extraction process, the study was submitted twice to approve the PI's access to the electronic information system. Appendix 5 includes this study's IRB approval documentation.

Summary

This chapter described a retrospective and descriptive study using clinical data retrieved from the electronic data repository of a large acute care hospital. The data included the administrative data (patient characteristics, clinical conditions, and nursing unit characteristics) and nursing documentation, including NANDA - I, NOC, and NIC, of patients admitted to the three adult ICUs of the hospital between March 25, 2010 and May 31, 2010. Frequency analysis, one-way ANOVA analysis, and multinomial logistic regression analysis were conducted to analyze data for the research questions.

Table 3.1 Variables of the Study

Variable name	Variable definition	Description
Patient Information		
Gender	Male or Female	Dichotomous; 0=Male, 1=Female
Age	The number of years after birth	Continuous;
Length of Stay in ICU	Duration of hospitalization in an ICU unit (Hours)	Continuous
Clinical Conditions		
Primary Medical Diagnoses	The primary medical diagnoses came from the International Classification of Disease, 9th Revision(Clinical Modification;ICD-9-CM) codes	Dichotomous; 0=Absent, 1=Present
Comorbid Medical Conditions	Clinical conditions that exist before admission and are not related to the principal reason for admission ; Measured by Elixhauser et al.' s method with the list of secondary medical diagnose extracted from the discharge summary (Elixhauser et al, 1998)	Continuous;
Nursing Unit Characteristic		
Intensive Care Unit	Type of intensive unit to which a patient was admitted	Categorical; 1= SICU, 2=MICU, 3=SICU
Skill Mix of Nursing Caregivers	The rate of RNs to all nursing direct caregivers during ICU stay	Continuous
Nursing Staff to Patient Ratio	The rate is determined by dividing the total number of nurses working during a given day by the patient census for that day	Categorical; 1= <1:1, 2= 1:1 ≥ and <1:1.5, 3 = ≥1:1.5

Table 3.1 Continued

Nursing diagnoses, interventions and outcomes		
NANDA - International	A clinical judgment about individual, family, or community responses to actual or potential health problem/life process	Dichotomous; 0=Absent,1=Present
Nursing Interventions Classification (NIC)	Any treatment, based upon clinical judgment and knowledge that a nurse performs to enhance patient/client outcomes	Dichotomous; 0=Absent,1=Present
Nursing Outcomes Classification (NOC)	An individual, family, or community state, behavior, or perception that is measured along a continuum in response to a nursing interventions	Continuous; 5 point Likert scale from 1(least desirable) to 5(most desirable)
The Change of NOC Outcome Score	The difference between a baseline rating of the outcome and post intervention rating of the outcome/The outcome ratings at the discharge	Categorical; 1= Improved, -1 =Declined, 0= No Change (rating stayed the same)

CHAPTER IV

STUDY FINDINGS

This chapter describes the study sample and the results of statistical analyses for 8 research questions. Frequency analysis, one-way analysis of variance, and multinomial logistic regression were used to answer the research questions. Continuous variables are reported as means (M) and standard deviations (SD), and categorical variables are reported as a cell size of a group (n) and percentage.

Description of Sample Data

The sample for the study was drawn from records of all patients older than 18 years admitted to 3 adult ICUs of a large acute care hospital in the Midwest between March 26, 2010 and May 31, 2010. Among 773 patient records during this period, 195 (25.2%) were excluded because there were no nursing care plans or NOC outcomes were not scored during ICU stay (n = 165, 85%); and the patients moved from one type of ICU unit to another ICU in the hospital (n= 29, 15%).

A total of 578 patient records were used for data analysis, and Table 4.1 describes the characteristics of the patients: 57.6% (n = 333) of the patients was male, while 42.4% (n = 245) were female. The mean age of the patients was 56.52 (SD = 17.19), and their ages ranged from 18 to 96 years. The ICU length of stay (LOS) averaged 64.40 (SD = 81.28) hours with a range of 2.0 to 738.50 (see Table 4.1). The patients had an average of 1.24 comorbid diseases with a range from 0 to 7.

Table 4.1. The Description of Patient Characteristics

Variables		Frequency	Percent	Cum. %*		
Gender	Female	245	42.4	42.4		
	Male	333	57.6	100.0		
		N	Mean	SD[1]	Min.[2]	Max. [3]
Age (Years)		578	56.52	17.19	18	96
	Female	245	56.58	18.67	18	96
	Male	333	56.47	16.05	18	93
ICU Length of Stay (Hours)			64.40	81.28	2.03	738.50
Comorbid Conditions			1.24	1.23	0	7
Total		578				

*Cumulative Percent

[1]Standard Deviation [2]Minimum [3]Maximum

The primary medical diagnoses for the patients were sorted by ICD - 9 - CM Diseases and Injuries Categories (Buck & American, 2010). The top 6 categories for the patient's primary medical diagnoses in this study were *Diseases of the circulatory system* (n=180, 31.1%), *Injury and poisoning* (n=112, 19.4%), *Diseases of the digestive system* (n=65, 11.2%), *Neoplasms* (n= 49, 8.5%), *Diseases of the respiratory system* (n=42, 7.3%) and *Infectious and parasitic diseases* (n=41, n=7.1%). These 6 ICD- 9 -CM categories accounted for 84.6 percent of the patients medical diagnoses in the ICU units. Many patients were classified into 12 other categories as described in Table 4.2.

Another way to examine the primary diagnosis data is through the use of clinical classification software (CCS). The CCS groups medical diagnoses and procedures into a manageable number of clinically meaning categories corresponding to the interest to researchers (Elixhauser, Steiner, & Palmer, 2011). This approach generated 121 clinical classifications from ICD-9-CM codes for 578 patients. The most common CCS categories of the patients' primary medical diagnoses included acute cerebrovascular disease (CVD) (n=57, 9.9%); septicemia (n=37, 6.4%), gastrointestinal (GI) hemorrhage (n=24, 4.2%); and acute myocardial infarction (MI) (n=20, 3.5%)(Table 4.3).

Table 4.2 The Distribution of Primary Medical Diagnoses

ICD Category name	Frequency	Percent	Cum. %*
Diseases of the Circulatory System	180	31.1	31.1
Injury and Poisoning	112	19.4	50.5
Diseases of the Digestive System	65	11.2	61.7
Neoplasms	49	8.5	70.2
Diseases of the Respiratory System	42	7.3	77.5
Infectious and Parasitic Diseases	41	7.1	84.6
Congenital Anomalies	17	2.9	87.5
Endocrine, Nutritional, and Metabolic Diseases, and Immunity Disorders	13	2.2	89.8
Symptoms, Signs, and Ill-Defined Conditions	12	2.1	91.8
Diseases of the Genitourinary System	10	1.7	93.6
Diseases of the Central Nervous System and Sense Organs	9	1.6	95.1
Mental Disorders	7	1.2	96.3
Diseases of the Musculoskeletal System and Connective Tissue	7	1.2	97.5
Complications of Pregnancy, Childbirth, and the Puerperium	4	0.7	98.2
Diseases of the Blood and Blood-Forming Organs	3	0.5	98.7
Diseases of the Skin and Subcutaneous Tissue	1	0.2	98.9
Supplementary Classification of Factors Influencing Health status and Contact with Health services	1	0.2	99.1
Missing	5	0.9	100
Total	578	100.0	

*Cumulative Percent

Table 4.3 Top 10 Clinical Classification Software (CCS) Categories

CCS categories	Frequency	Percent	Cum.%*
Acute Cerebrovascular Disease	57	9.9	9.9
Septicemia	37	6.4	16.3
Gastrointestinal Hemorrhage	24	4.2	20.4
Acute Myocardial Infarction	20	3.5	23.9
Complication of Device; Implant or Graft	19	3.3	27.2
Respiratory Failure; Insufficiency; Arrest (adult)	17	2.9	30.1
Aneurysm	16	2.8	32.9
Other and Unspecified Benign Neoplasm	16	2.8	35.6
Poisoning by Psychotropic Agents	16	2.8	38.4
Coronary Atherosclerosis and Other Heart Disease	15	2.6	41.0
Heart Valve Disorders	14	2.4	43.4
Complications of Surgical Procedures or Medical Care	13	2.2	45.7
Other Liver Diseases	12	2.1	47.8
Intracranial Injury	11	1.9	49.7
Poisoning by Other Medications and Drugs	11	1.9	51.6
Total	578	100.0	

*Cumulative Percent

Table 4.5 presents the nursing characteristics of the study sample. The types of ICU that patients were admitted to were: SICU (50.9%), MICU (35.8%) and CVICU (13.3%). The average nursing staff to patient ratio was 1:1.37 with a range of 0.92 - 1.70. The nursing staff to patient ratio of CVICU was higher than the other two ICUs (M =1.45, SD= 0.1). The skill mix of nursing caregivers, which is the ratio of registered nurses to other nursing caregivers, ranged from 0.74 to 1 with an average of 0.90. Among the three ICUs, the ratio of MICU was the highest. Each patient had an average of 3.69 NANDA - I diagnoses (S.D. = 2.39, Range = 1-16); 4.06 NOC outcomes (S.D. = 2.53, Range=1-18); and 5.98 NIC interventions (S.D. = 3.89, Range=0 -26) (Table 4.4).

Table 4.4 The Number of NANDA - I, NOC, and NIC per Patient (N=578)

	Mean	SD[1]	Min.[2]	Max.[3]
Number of NANDA - I Diagnoses	3.69	2.39	1	16
Number of NOC Outcomes	4.06	2.53	1	18
Number of NIC Interventions	5.98	3.89	0	26

[1]Standard Deviation [2]Minimum [3]Maximum

Table 4.5 The Description of Nursing Characteristics

Nursing Characteristics		Frequency	Percent	Cum. %*		
Type of ICU						
	SICU	294	50.9	50.9		
	MICU	207	35.8	86.7		
	CVICU	77	13.3	100.0		
	Total	578	100	100		
		N	Mean	SD[1]	Min.[2]	Max.[3]
Nursing staff to Patient Ratio						
	SICU	294	1.33	0.15	.92	1.70
	MICU	206	1.39	0.08	1.19	1.64
	CVICU	76	1.45	0.12	1.22	1.65
	Total	576	1.37	0.13	.92	1.70
Skill mix of Nursing Caregivers						
	SICU	294	0.88	0.03	.74	.96
	MICU	207	0.93	0.02	.87	1.00
	CVICU	76	0.89	0.03	.83	.98
	Total	577	0.90	0.04	0.74	1

*Cumulative Percent

[1]Standard Deviation [2]Minimum [3]Maximum

Research Question One

Research question 1 was to identify the NANDA - I diagnoses most frequently selected by ICU nurses for patients during an ICU stay. A total of 81 different NANDA - I diagnoses were selected at least once by ICU nurses. These 81 nursing diagnoses were used a total of 2,135 times and for an average of 3.69 diagnoses selected per patient. Table 4.6 shows all NANDA - I diagnoses selected by ICU nurses in descending order. *Acute Pain* (n=267) was the most frequently used diagnosis in ICU nursing care plans and accounted for 12.5% of the total NANDA - I diagnoses. The top 10 most commonly used NANDA- I diagnoses represent half of the total NANDA - I diagnoses used by nurses working in intensive care: *Acute Pain* (n= 267, 12.5%); *Impaired Gas Exchange* (n= 160, 7.5%); *Ineffective Airway Clearance* (n=157, 7.4%); *Risk for Infection* (n=149, 7.0%); *Ineffective Tissue Perfusion: Pulmonary* (n=117, 5.5%); *Risk for Falls* (n=102, 4.8%); *Deficient Knowledge Pre/Post Procedure/Surgery* (n=85, 4.0%); *Impaired Skin Integrity* (n=77, 3.6%); *Activity Intolerance* (n=71, 3.3%); and *Deficient Knowledge, Disease Process* (n=58, 2.7%) This pattern of use illustrates how nurses customize care plans in ICUs to meet the patient's care needs.

Table 4.6 NANDA - I Diagnoses Used in ICU Nursing Care Plans

NANDA - I Diagnoses	Frequency	Percent	Cum.%*
Acute Pain	267	12.5	12.5
Impaired Gas Exchange	160	7.5	20.0
Ineffective Airway Clearance	157	7.4	27.4
Risk for Infection	149	7.0	34.3
Ineffective Tissue Perfusion: Pulmonary	117	5.5	39.8
Risk for Falls	102	4.8	44.6
Deficient Knowledge Pre/Post Procedure/Surgery	85	4.0	48.6
Impaired Skin Integrity	77	3.6	52.2
Activity Intolerance	71	3.3	55.5
Deficient Knowledge, Disease Process	58	2.7	58.2
Ineffective Breathing Pattern	53	2.5	60.7
Risk for Impaired Skin Integrity	52	2.4	63.1
Risk for Bleeding	50	2.3	65.5
Impaired Physical Mobility	42	2.0	67.4
Anxiety	36	1.7	69.1
Ineffective Tissue Perfusion, Cerebral	31	1.5	70.6
Nausea	31	1.5	72.0
Decreased Cardiac Output	30	1.4	73.4
Imbalanced Nutrition: Less than Body Requirements	30	1.4	74.8
Acute Confusion	29	1.4	76.2
Decreased Intracranial Adaptive Capacity	28	1.3	77.5
Risk for Imbalanced Fluid Volume	27	1.3	78.8
Sleep Deprivation	27	1.3	80.0
Ineffective Tissue Perfusion: Cardiac	23	1.1	81.1
Ineffective Coping	22	1.0	82.2
Risk for Aspiration	22	1.0	83.2
Excess Fluid Volume	20	.9	84.1
Risk for Constipation	18	.8	85.0
Risk for Imbalanced Body Temperature	17	.8	85.8
Deficient Fluid Volume	16	.7	86.5
Risk for Activity Intolerance	16	.7	87.3
Risk for Deficient Fluid Volume	16	.7	88.0
Mood Alteration: Depression	15	.7	88.7
Risk for Peripheral Neurovascular Dysfunction	15	.7	89.4
Risk for Suicide	15	.7	90.1
Disturbed Thought Processes	13	.6	90.7
Impaired Swallowing	13	.6	91.3
Diarrhea	11	.5	91.9
Fatigue	10	.5	92.3
Impaired Spontaneous Ventilation	10	.5	92.8
Impaired Verbal Communication	10	.5	93.3
Chronic Pain	9	.4	93.7
Impaired Bed Mobility	9	.4	94.1
Ineffective Tissue Perfusion, Renal	9	.4	94.5
Risk for Withdrawal: Alcohol/Drugs	9	.4	94.9
Risk for Injury	7	.3	95.3
Impaired Tissue Integrity	6	.3	95.6

Table 4-6. Continued

Ineffective Tissue Perfusion: Cerebral	6	.3	96.1
Constipation	5	.2	96.3
Hopelessness	5	.2	96.6
Ineffective Tissue Perfusion	5	.2	96.8
Ineffective Tissue Perfusion, Peripheral	5	.2	97.0
Noncompliance	5	.2	97.3
Risk for Unstable Blood Glucose	5	.2	97.5
Urinary Retention	5	.2	97.8
Deficient Knowledge, Insulin Therapy	4	.2	97.9
Grieving	4	.2	98.1
Self-Care Deficit	4	.2	98.3
Impaired Oral Mucous Membrane	3	.1	98.5
Readiness for Enhanced Family Coping	3	.1	98.6
Spiritual Distress	3	.1	98.7
Unilateral Neglect	3	.1	98.9
Bathing/Hygiene Self-Care Deficit	2	.1	99.0
Deficient Knowledge	2	.1	99.1
Dysfunctional Ventilation Weaning Response	2	.1	99.2
Ineffective Thermoregulation	2	.1	99.3
Risk for Self-Directed Violence	2	.1	99.3
Social Isolation	2	.1	99.4
Airway Clearance, Ineffective	1	.0	99.5
Disturbed Body Image	1	.0	99.5
Disturbed Sensory Perception, Kinesthetic	1	.0	99.6
Disturbed Sensory Perception, Visual	1	.0	99.6
Effective Breastfeeding	1	.0	99.7
Imbalanced Nutrition: More than Body Requirements	1	.0	99.7
Impaired Memory	1	.0	99.8
Impaired Urinary Elimination	1	.0	99.8
Inadequate Oral Food Beverage Intake	1	.0	99.9
Interrupted Family Process	1	.0	99.9
Readiness for Enhanced Spiritual Well-Being	1	.0	100.0
Risk for Latex Allergy Response	1	.0	100.0
Total	2135	100.0	

*Cumulative Percent

Note: The highlights are the ten most common NANDA - I diagnoses.

The italic diagnosis is not NANDA - I diagnosis (NANDA – I, 2009-2011).

Research Question Two

Question 2 is to identify the NOC outcomes selected by nurses for ICU patient care and to explore changes in the selected NOC outcome scores for the patients over their ICU stay. All NOC outcomes used by ICU nurses are presented in Table 4.7. Seventy nine different NOC outcomes were generated from a total of 2345 NOC outcomes. Each patient had an average of 4.06 NOC outcomes during the ICU stay (SD = 2.53, Range=1-16). The eight most frequently selected NOC outcomes are *Pain Level* (n= 276, 11.8%); *Respiratory Status: Gas Exchange* (n=172, 7.3%); *Respiratory Status: Airway Patency* (n=157, 6.7%); *Infection Severity* (n=147, 6.7%); *Tissue Integrity: Skin and Mucous Membranes* (n=134, 5.7%); *Knowledge: Treatment Procedure* (n=129, 5.5%); *Tissue Perfusion: Pulmonary* (n=117, 5.5%); and *Knowledge: Fall Prevention* (n=101, 5%). While these NOC outcomes were only 10 % of the NOC outcome labels used by ICU nurses, they account for 52.4% of the total times NOC outcomes were used for patients in the IUC. The three outcomes in italics are not found as written in NOC (Moorhead et al., 2008).

Table 4.7 NOC Outcomes Used in ICU Nursing Care Plans

	Frequency	Percent	Cum. %*
Pain Level	276	11.8	11.8
Respiratory Status: Gas Exchange	172	7.3	19.1
Respiratory Status: Airway Patency	157	6.7	25.8
Infection Severity	147	6.3	32.1
Tissue Integrity: Skin And Mucous Membranes	134	5.7	37.8
Knowledge: Treatment Procedure	129	5.5	43.3
Tissue Perfusion: Pulmonary	117	5	48.3
Knowledge: Fall Prevention	101	4.3	52.6
Fall Prevention: Behavior	77	3.3	55.9
Activity Tolerance	70	3	58.8
Pain Control	56	2.4	61.2
Knowledge: Illness Care	53	2.3	63.5
Respiratory Status: Ventilation	53	2.3	65.8
Blood Loss Severity	50	2.1	67.9
Mobility	42	1.8	69.7
Anxiety Level	36	1.5	71.2
Aspiration Prevention	35	1.5	72.7
Fluid Balance	32	1.4	74.1
Nausea and Vomiting Severity	31	1.3	75.4
Nutritional Status	31	1.3	76.7
Cardiac Pump Effectiveness	30	1.3	78
Acute Confusion Level	29	1.2	79.2
Coping	29	1.2	80.5
Neurological Status	28	1.2	81.7
Hydration	27	1.2	82.8
Sleep	27	1.2	84
Tissue Perfusion: Cerebral	27	1.2	85.1
Endurance	26	1.1	86.2
Tissue Perfusion: Cardiac	23	1	87.2
Fluid Overload Severity	20	0.9	88.1
Gastrointestinal Function	18	0.8	88.8
Depression Level	17	0.7	89.6
Bowel Elimination	16	0.7	90.2
Neurologic Status: Peripheral	15	0.6	90.9
Suicide Self-Restraint	15	0.6	91.5
Risk Control: Hyperthermia	14	0.6	92.1
Seizure Control	12	0.5	92.6
Risk Control: Hypothermia	11	0.5	93.1
Body Positioning: Self-Initiated	10	0.4	93.5
Cognitive Orientation	10	0.4	93.9
Communication	10	0.4	94.4
Swallowing Status	10	0.4	94.8
Tissue Perfusion: Peripheral	10	0.4	95.2

Table 4.7 Continued

Kidney Function	9	0.4	95.6
Substance Withdrawal Severity	9	0.4	96
Cognition	7	0.3	96.3
Health Seeking Behavior	6	0.3	96.5
Knowledge: Personal Safety	6	0.3	96.8
Self-Care: Activities Of Daily Living (ADL)	6	0.3	97.1
Blood Glucose Level	5	0.2	97.3
Compliance Behavior	5	0.2	97.5
Hope	5	0.2	97.7
Urinary Elimination	5	0.2	97.9
Diabetes Self-Management	4	0.2	98.1
Grief Resolution	4	0.2	98.3
Spiritual Health	4	0.2	98.4
Family Coping	3	0.1	98.6
Heedfulness Of Affected Side	3	0.1	98.7
Oral Hygiene	3	0.1	98.8
Treatment Procedure	3	0.1	98.9
Infection Protection	2	0.1	99
Knowledge: Treatment Regimen	2	0.1	99.1
Pain: Disruptive Effects	2	0.1	99.2
Self-Mutilation Restraint	2	0.1	99.3
Social Involvement	2	0.1	99.4
Thermoregulation: Peds	2	0.1	99.4
Allergic Response: Systemic	1	0	99.5
Balance	1	0	99.5
Breastfeeding Establishment: Maternal	1	0	99.6
Cognitive Restructuring	1	0	99.6
Dignified Life Closure	1	0	99.7
Family Integrity	1	0	99.7
Free From Accidental Physical Injury	1	0	99.7
Ineffective Coping	1	0	99.8
Memory	1	0	99.8
Mutual Goal Setting	1	0	99.9
Oral Intake	1	0	99.9
Risk Control	1	0	100
Sensory Function: Vision	1	0	100
Total	2345	100	

*Cumulative Percent

Note: The highlights are the 10 most common NOC outcomes

In addition, how often NOC outcomes were rated to measure patient status over an ICU stay was examined. NOC outcomes were rated an average of 2.3 times (Range = 1 -11 times) over the ICU stay. As a result, on average the NOC outcome was rated once every 35.1 hours (Range = 2.0 – 738.5 hours). Table 4.8 shows averages of the frequency and averages of hours per score for each NOC outcome during IUC stay. Only 26.4% of NOC outcomes were rated an average of once per day (24 hours) and 62.3% of NOC outcomes were rated once every 2 days for patients in this study. The longest time frame between ratings was 99.2 hours for *Dignified Life Closure* (Table4.9).

Table 4.8 Average Number of Hours between Ratings for NOC Outcomes

Average hours	# of NOCs[1]	Percent	Cum.%*
≤ 24	21	26.3	26.3
Between 24 and 36	32	41.3	67.5
Between 36 and 48	16	20.0	86.6
> 48	10	12.5	12.5
	79	100	100

[1]The number of NOC outcomes

*Cumulative Percent

Table 4.9 Average Hours between Ratings of Specific NOC Outcomes

		Frequency of scores		Hours	
NOC outcomes	N	M[a]	SD[b]	M[a]	SD[b]
Pain Level	276	2.4	1.3	26.2	22.9
Respiratory Status: Gas Exchange	172	3.1	1.9	39.1	33.2
Respiratory Status: Airway Patency	157	3.1	1.9	40.0	35.4
Infection Severity	147	2.2	1.2	35.1	45.0
Tissue Integrity: Skin and Mucous Membranes	134	2.3	1.3	34.4	27..4
Knowledge: Treatment Procedure	129	2.0	1.0	38.9	67.3
Tissue perfusion: Pulmonary	117	3.0	1.8	44.1	34.8
Knowledge: Fall Prevention	101	2.0	1.0	34.5	43.5
Fall Prevention: Behavior	77	1.9	1.0	35.8	44.5
Activity Tolerance	70	2.1	1.3	34.6	41.4
Total	2345	2.3	1.5	35.1	38.5

[a] Mean [b] Standard Deviation

The average score for a total of 2,345 NOC outcomes was 3.29 (S.D. =0.96, Range =1-5). In the NOC Classification a rating of 5 is the highest rating and a rating of 1 is the lowest rating a patient can score on an outcome. *Allergic Response: Systemic* (M = 5.00), *Oral Hygiene* (M = 4.33, SD = 0.58), and *Family Coping* (M = 4.33, S.D. = 0.58) were the three NOC outcomes that had the highest average scores, while *Oral Intake* (M = 1), *Hope* (M = 1.25, SD = 0.50), *Thermoregulation: Peds* (M=2, S.D. = 0.00) were 3 NOC outcomes that had the lowest average scores (Appendix D). The change of NOC outcome scores was calculated by subtracting the first score from the last score of NOC outcome over the patient's ICU stay. This change of NOC outcome score was divided into three categories: 'Declined,' 'No change,' and 'Improved.' Among a total of 2,345 NOC outcomes, the scores of 1325 NOC outcomes (56.5%) over ICU stay did not change (including the frequency '1' of scoring). 302 (12.9%) NOC outcome scores decreased at the last rating over ICU stay, while 718 (30.6%) NOC outcomes scores increased at the last rating over the patient's ICU stay.

Table 4.10 shows the averages and change scores of the top 10 NOC outcomes during a patient's ICU stay. Among them, the top 5 NOC outcomes were used in the analysis of research questions 7 and 8.

Table 4.10 Average and Change of the Top Ten NOC Outcome Scores over ICU Stay

		The change of NOC outcome score			Average of score	
Top ten NOC outcomes	n	Declined	No change	Improved	M[a]	SD[b]
Pain Level	276	44	152	80	3.6	0.9
Respiratory Status: Gas Exchange	172	20	78	74	3.4	0.8
Respiratory Status: Airway Patency	157	20	63	74	3.2	0.8
Infection Severity	147	27	80	40	3.5	0.9
Tissue Integrity: Skin and Mucous Membranes	134	27	79	28	3.6	1.0
Knowledge: Treatment Procedure	129	11	75	43	3.0	0.8
Tissue perfusion: Pulmonary	117	17	48	52	3.4	0.9
Knowledge: Fall Prevention	101	12	66	23	3.1	1.1
Fall Prevention: Behavior	77	8	51	18	3.4	1.1
Activity Tolerance	70	6	47	17	2.8	0.9
Total	2345	302 (12.9%)	1325 (56.5%)	718 (30.6%)	3.3	1.0

[a] Mean [b] Standard Deviation

Research Question Three

Question 3 was to identify NIC interventions most frequently used for patients receiving ICU nursing care. Ninety four different NIC interventions were used in ICU nursing care plans in this study. These NIC interventions were used a total 3564 times in ICU nursing care plans. Each patient had an average of 5.98 NIC interventions (Range= 0 – 26) over the ICU stay. All NIC interventions used by ICU nurses are presented in Table 4.11. The ten most common NIC interventions are *Pain Management* (n=338, 9.5%); *Ventilation Assistance* (n=212, 5.9%); *Fall Prevention* (n= 186, 5.2%); *Acid-Base Management: Respiratory Acidosis* (n=161, 4.5%); *Airway Management* (n=157, 4.45%); *Airway Suctioning* (n=153, 4.3%); *Infection Protection* (n=153, 4.3%); *Acid-Base Management* (n=136, 3.8%); *Teaching: Procedure/Treatment* (n=136, 3.8%); and *Skin Surveillance* (n=135, 3.8%). A wide variety of nursing interventions were provided to patients in these ICU units.

Table 4.11 NIC Interventions used in ICU Nursing Care Plans.

NIC Interventions	Frequency	Percent	Cum. %*
Pain Management	338	9.5	9.5
Ventilation Assistance	212	5.9	15.4
Fall Prevention	186	5.2	20.7
Acid-Base Management: Respiratory Acidosis	161	4.5	25.2
Airway Management	157	4.4	29.6
Airway Suctioning	153	4.3	33.9
Infection Protection	153	4.3	38.2
Acid-Base Management	136	3.8	42.0
Teaching: Procedure/Treatment	136	3.8	45.8
Skin Surveillance	135	3.8	49.6
Infection Control	130	3.6	53.2
Energy Management	93	2.6	55.8
Teaching: Preoperative	80	2.2	58.1
Pressure Management	79	2.2	60.3
Wound Care	75	2.1	62.4
Anxiety Reduction	74	2.1	64.5
Exercise Promotion: Strength Training	72	2.0	66.5
Activity Therapy	67	1.9	68.4
Analgesic Administration	58	1.6	70.0
Teaching: Disease Process	56	1.6	71.6
Cardiac Care, Acute	52	1.5	73.0
Fluid Management	51	1.4	74.5
Bleeding Precautions	49	1.4	75.8
Aspiration Precautions	46	1.3	77.1
Coping Enhancement	45	1.3	78.4
Exercise Promotion	42	1.2	79.6
Neurologic Monitoring	41	1.2	80.7
Nutrition Management	33	.9	81.6
Behavior Management: Self-Harm	32	.9	82.5
Nutrition Therapy	32	.9	83.4
Circulatory Care: Arterial Insufficiency	31	.9	84.3
Nausea Management	31	.9	85.2
Cerebral Perfusion Promotion	30	.8	86.0
Circulatory Care: Venous Insufficiency	29	.8	86.8
Delirium Management	29	.8	87.7

Table 4.11 Continued

Fluid Monitoring	29	.8	88.5
Temperature Regulation	29	.8	89.3
Cerebral Edema Management	28	.8	90.1
Cognitive Restructuring	27	.8	90.8
Sleep Enhancement	27	.8	91.6
Cognitive Stimulation	19	.5	92.1
Bowel Management	18	.5	92.6
Diet Staging	18	.5	93.1
Mood Management	16	.4	93.6
Seizure Precautions	15	.4	94.0
Suicide Prevention	15	.4	94.4
Peripheral Sensation Management	14	.4	94.8
Pressure Ulcer Care	14	.4	95.2
Active Listening	11	.3	95.5
Diarrhea Management	11	.3	95.8
Artificial Airway Management	10	.3	96.1
Communication Enhancement: Speech Deficit	9	.3	96.4
Self-Responsibility Facilitation	9	.3	96.6
Substance Use Treatment: Alcohol Withdrawal	9	.3	96.9
Nutritional Monitoring	7	.2	97.1
Positioning	7	.2	97.3
Self-Care Assistance	7	.2	97.4
Constipation/Impaction Management	5	.1	97.6
Environmental Management	5	.1	97.7
Grief Work Facilitation	5	.1	97.9
Hyperglycemia Management	5	.1	98.0
Hypoglycemia Management	5	.1	98.1
Mutual Goal Setting	5	.1	98.3
Urinary Retention Care	5	.1	98.4
Family Support	4	.1	98.5
Hope Inspiration	4	.1	98.7
Substance Use Treatment: Drug Withdrawal	4	.1	98.8
Unilateral Neglect Management	4	.1	98.9
Mechanical Ventilatory Weaning	3	.1	99.0
Oral Health Restoration	3	.1	99.0
Seizure Management	3	.1	99.1

Table 4.11 Continued

Spiritual Support	3	.1	99.2
Behavior Management	2	.1	99.3
Communication Enhancement: Visual Deficit	2	.1	99.3
Emotional Support	2	.1	99.4
Knowledge: Treatment Procedure	2	.1	99.4
Memory Training	2	.1	99.5
Nutrition Support	2	.1	99.6
Socialization Enhancement	2	.1	99.6
Breastfeeding Assistance	1	.0	99.6
Dying Care	1	.0	99.7
Exercise Therapy: Balance	1	.0	99.7
Family Process Maintenance	1	.0	99.7
Fluid Balance	1	.0	99.7
Hallucination Management	1	.0	99.8
Health Education	1	.0	99.8
Latex Precautions	1	.0	99.8
Reality Orientation	1	.0	99.9
Risk Control: Hyperthermia	1	.0	99.9
Self-Esteem Enhancement	1	.0	99.9
Spiritual Growth Facilitation	1	.0	99.9
Surveillance: Safety	1	.0	100.0
Teaching: Individual	1	.0	100.0
Total	3564	100.0	

*Cumulative Percent

Research Question Four

Question 4 is to identify the linkages of NANDA - I, NOC and NIC (NNN) selected most frequently by nurses for ICU patient care. 148 different NNN linkages were identified in the ICU nursing care plans. Table 4.12 displays the top most common NNN linkages used in ICU nursing care plans. *Acute pain – Pain level – Pain management* was the most frequently used by ICU nurses (n=276, 7.7%).

Table 4.12 Top NNN linkages Selected for Patients in ICUs

NANDA- I	NOC	NIC	N	%	Cum.%
Acute Pain	Pain Level	Pain Management	276	7.7	7.7
Impaired Gas Exchange	Respiratory Status: Gas Exchange	Acid-Base Management : Respiratory Acidosis	160	4.5	12.2
		Ventilation Assistance	160	4.5	16.7
Ineffective Airway Clearance	Respiratory Status: Airway Patency	Airway Management	157	4.4	21.1
		Airway Suctioning	153	4.3	25.4
Risk for Infection	Infection Severity	Infection Protection	147	4.1	29.5
		Infection Control	130	3.6	33.1
Ineffective Tissue Perfusion: Pulmonary	Tissue Perfusion: Pulmonary	Acid-Base Management	136	3.8	37.0
Risk for Falls	Knowledge: Fall Prevention	Fall Prevention	101	2.8	39.8
	Fall Prevention Behavior	Fall Prevention	77	2.2	42.0
Deficient Knowledge Pre/Post Procedure/Surgery	Knowledge: Treatment Procedure	Teaching: Preoperative	79	2.2	44.2
	Knowledge: Treatment Procedure	Teaching: Procedure/Treatment	76	2.1	46.3
Impaired Skin Integrity	Tissue Integrity: Skin and Mucous Membranes	Wound Care	75	2.1	48.4
		Skin Surveillance	75	2.1	50.5
		Pressure Management	73	2.0	52.6
Activity Intolerance	Activity Tolerance	Exercise Promotion: Strength Training	72	2.0	54.6
		Energy Management	70	2.0	56.5
Acute Pain	Pain Control	Pain Management	56	1.6	58.1
Deficient Knowledge, Disease Process	Knowledge: Illness Care	Teaching: Disease Process	56	1.6	59.7

Research Question Five

Question 5 is to compare NIC interventions and NOC outcomes actually selected by ICU nurses with core interventions and outcomes for critical care nursing identified by experts. Table 4.13 shows the comparison between NIC interventions recommended by experts and interventions used by ICU nurses. Fifteen NIC interventions were identical on both lists. These NIC interventions make up 29% of the 56 core interventions for critical care nursing suggested in the NIC book and 17% of the 93 different NIC interventions selected by ICU nurses in practice. Unique NIC interventions in each group are also presented in Table 4.13. Seventy seven of the NIC interventions (83%) used in this study for ICU nursing care plans were not on the list of core inventions. In particular, 7 NIC interventions among the top 10 common NIC interventions selected by ICU nurses were not on the core intervention list: *Ventilation Assistance* (2nd), *Fall Prevention* (3rd), *Acid-Base Management: Respiratory Acidosis* (4th), *Infection Protection* (7th), *Acid-Base Management* (8th), and *Skin Surveillance* (10th).

Table 4.14 shows the comparison between NOC outcomes selected by ICU nurses in practice and core outcomes for critical care nursing suggested by experts. Twenty two NOC outcomes were found in both lists. These NOC outcomes make up 28% of the 79 NOC outcomes selected by ICU nurses and 37% of the 59 core outcomes for critical care nursing. Unique NOC outcomes in each group are presented in Table 4.14. Seven of the ten most common NOC outcomes selected by ICU nurses were not on the core NOC outcomes for critical care nursing: *Respiratory Status: Gas Exchange* (2nd), Infection Severity (4th), *Tissue Integrity: Skin and Mucous Membranes* (5th), *Knowledge: Fall Prevention* (8th), *Fall Prevention: Behavior* (9th), and *Activity Tolerance* (10th).

Table 4.13 Comparison of NIC Interventions Selected by ICU Nurses with Core Interventions for Critical Care Nursing

Identical NIC interventions (Freq.≥30)	n	%	Identical NIC interventions (Freq.<30)	n	%
Pain Management	338	9.5	Fluid Monitoring	29	.8
Airway Management	157	4.4	Temperature Regulation	29	.8
Airway Suctioning	153	4.3	Artificial Airway Management	10	.3
Teaching: Procedure/Treatment	136	3.8	Positioning	7	.2
Anxiety Reduction	74	2.1	Mechanical Ventilatory Weaning	3	.1
Analgesic Administration	58	1.6	Emotional Support	2	.1
Cardiac Care, Acute	52	1.5			
Fluid Management	51	1.4			
Neurologic Monitoring	41	1.2			
Nausea Management	31	.9			

Most Common NIC Interventions in Nursing Care Plans (Freq. ≥ 30) but Not in Core NIC Interventions	n	%
Ventilation Assistance	212	5.9
Fall Prevention	186	5.2
Acid-Base Management: Respiratory Acidosis	161	4.5
Infection Protection	153	4.3
Acid-Base Management	136	3.8
Skin Surveillance	135	3.8
Infection Control	130	3.6
Energy Management	93	2.6
Teaching: preoperative	80	2.2
Pressure Management	79	2.2
Wound Care	75	2.1
Exercise Promotion: Strength Training	72	2.0
Activity Therapy	67	1.9
Teaching: Disease Process	56	1.6
Bleeding Precautions	49	1.4
Aspiration Precautions	46	1.3
Coping Enhancement	45	1.3
Exercise Promotion	42	1.2
Nutrition Management	33	.9
Behavior Management: Self-Harm	32	.9
Nutrition Therapy	32	.9
Circulatory Care: Arterial Insufficiency	31	.9
Cerebral Perfusion Promotion	30	.8

Table 4.13 Continued

Core Interventions for Critical Care Nursing but Not in Nursing Care Plans	
Acid-Base Monitoring	Fluid/Electrolyte Management
Cardiac Precautions	Hemodynamic Regulation
Caregiver Support	Intracranial Pressure (ICP) Monitoring
Circulatory Care: Mechanical Assist Device	Intravenous (IV) Therapy
Code Management	Invasive Hemodynamic Monitoring
Decision-Making Support	Mechanical Ventilation Management: Invasive
Defibrillator Management: External	Mechanical Ventilation Management
Defibrillator Management: Internal	Medication Administration
Delegation	Medication Administration: Intravenous (IV)
Discharge Planning	Multidisciplinary Care Conference
Documentation	Oxygen Therapy
Electrolyte Management	Pacemaker Management: Permanent
Electrolyte Monitoring	Pacemaker Management: Temporary
Family Involvement Promotion	Patient Rights Protection
Family Presence Facilitation	

*The highlights are the 10 most common NIC Interventions used in ICU nursing care plans

Table 4.14 Comparison of NOC Outcomes Selected by ICU Nurses with Core Outcomes for Critical Care Nursing

Identical NOC outcomes (Freq. ≥ 30)	n	%	Identical NOC outcomes (Freq. <30)	n	%
Pain level	276	12	Acute Confusion Level	29	1.2
Respiratory Status: Airway Patency	157	6.7	Tissue Perfusion: Cerebral	27	1.2
Tissue perfusion: pulmonary	117	5	Tissue perfusion: cardiac	23	1
Pain Control	56	2.4	Fluid Overload Severity	20	0.9
Blood Loss Severity	50	2.1	Neurologic Status: Peripheral	15	0.6
Anxiety Level	36	1.5	Cognitive Orientation	10	0.4
Nausea and Vomiting Severity	31	1.3	Swallowing Status	10	0.4
Nutritional Status	31	1.3	Kidney Function	9	0.4
Cardiac Pump Effectiveness	30	1.3	Urinary Elimination	6	0.3
			Family Coping	3	0.1
			Pain: Disruptive Effects	2	0.1
			Allergic Response: Systemic	1	0.1
			Dignified Life Closure	1	0.1

Most Common NOC Ooutcomes in Nursing Care Plans(Freq. ≥ 30) but Not in Core Outcomes	n	%
Respiratory Status: Gas Exchange	172	7.3
Infection Severity	147	6.3
Tissue Integrity: Skin and Mucous Membranes	130	5.5
Knowledge: Treatment Procedure	129	5.5
Knowledge: Fall Prevention	101	4.3
Fall Prevention: Behavior	77	3.3
Activity Tolerance	70	3
Knowledge: Illness Care	53	2.3
Respiratory Status: Ventilation	53	2.3
Mobility	42	1.8
Aspiration Prevention	35	1.5
Fluid Balance	32	1.4

Core Outcomes for Critical Care Nursing but Not in Nursing Care Plans

Acid-Base Monitoring	Mechanical Ventilation Management: Invasive
Cardiac Precautions	Mechanical Ventilation Management
Caregiver Support	Medication Administration
Circulatory Care: Mechanical Assist Device	Medication Administration: Intravenous (IV)
Code Management	Multidisciplinary Care Conference
Decision-Making Support	Oxygen Therapy
Defibrillator Management: External	Pacemaker Management: Permanent
Defibrillator Management: Internal	Pacemaker Management: Temporary
Delegation	Patient Rights Protection
Discharge Planning	Physician Support

Table 4.14 Continued

Documentation	Respiratory Monitoring
Electrolyte Management	Sedation Management
Electrolyte Monitoring	Shock Management
Family Involvement Promotion	Technology Management
Family Presence Facilitation	Thrombolytic Therapy Management
Fluid/Electrolyte Management	Transport: Interfacility
Hemodynamic Regulation	Transport: Intrafacility
Intracranial Pressure (ICP) Monitoring	Visitation Facilitation
Intravenous (IV) Therapy	Vital Signs Monitoring
Invasive Hemodynamic Monitoring	Vomiting Management

*The highlights are the 10 most common NOC Outcomes used in ICU nursing care plans

Research Question Six

Question 6 was "What are the differences and similarities between how NANDA - I, NOC and NIC are used in the three different ICU settings?"

The 10 most frequently used NANDA - I diagnoses for each ICU are presented in descending order in Table 4.15. The table also describes the proportion of each NANDA - I diagnosis used in each ICU (All frequencies of NANDA-diagnoses in each unit are attached in Appendix 4). Six NANDA - I diagnoses were among the ten most commonly used diagnoses in all three ICUs: *Acute Pain*, *Ineffective Airway Clearance*, *Impaired Gas Exchange*, *Risk for Falls*, *Ineffective Tissue Perfusion: Pulmonary*, and *Activity Intolerance*. The unique NANDA - I diagnoses are *Impaired Skin Integrity* and *Impaired Physical Mobility* for the SICU; *Risk for Bleeding*, *Ineffective Breathing Pattern*, and *Deficient Knowledge: Disease Process* for the MICU; and *Decreased Cardiac Output*, *Risk for Impaired Skin Integrity*, and *Ineffective Tissue Perfusion: Cardiac* for the CVICU. Among a total of 16 NANDA - I diagnoses in Table 4.15, the frequencies of 11 NANDA - I diagnoses differed significantly among the three ICUs with 0.003 (=0.05/16) alpha level (Refer to chi-square values and p value in Table 4.15).

Table 4.16 compares the ten most commonly used NIC interventions in the three ICUs. Four NIC interventions were among the ten most commonly used in all three ICUs: *Acid-Base Management: Respiratory Acidosis*, *Airway Management*, *Pain Management* and *Ventilation Assistance*. *Cardiac Care, Acute* and *Teaching Preoperative* were the unique NIC interventions for the CVICU. Among a total of 14 NIC interventions in Table 4.16, the frequencies of 9 NIC interventions were significantly different among the three ICU units with 0.004 (=0.05/14) alpha level (Refer to chi-square values and p value in table 4.16).

The ten most frequently used NOC outcomes in each unit are presented in Table 4. 17. These NOC outcomes accounted for 66.4% of the NOC outcomes for the SICU; 53.5% for the MICU; and 66.1% for the CVICU. Five of the NOC outcomes appeared on the list of ten most common NOC outcomes for all three ICUs: *Pain Level, Respiratory Status: Gas Exchange, Respiratory Status: Airway Patency, Knowledge: Fall Prevention and Tissue Perfusion: Pulmonary.* On the other hand, *Activity Tolerance* for the SICU, *Blood Loss Severity, Respiratory Status: Ventilation,* and *Fluid Balance* for the MICU, and *Cardiac Pump Effectiveness, Endurance,* and *Tissue Perfusion Cardiac* for the CVICU were ranked within the top ten NOC outcomes used in each ICU. Among 16 NOC outcomes, the frequencies of 9 NOC outcomes were significantly different among three units, and each NOC outcome was indented in Table 4.17 (Refer to chi-square values and p value in table 4.17).

Table 4.15 Comparison of the Most Frequently Used NANDA - I Diagnoses in Three ICUs

SICU (n=1217)	N	%	Cum.%	MICU (n=645)	n	%	Cum.%	CVICU (n=273)	n	%	Cum.%
Acute Pain*	210	17.3	17.3	Impaired Gas Exchange*	64	9.9	9.9	Acute Pain*	27	9.9	9.9
Risk for Infection	99	8.1	25.4	Ineffective Airway Clearance	57	8.8	18.8	Deficient Knowledge Pre/Post Procedure/Surgery*	23	8.4	18.3
Ineffective Airway Clearance	80	6.6	32.0	Risk for Infection	42	6.5	25.3	Ineffective Airway Clearance	20	7.3	25.6
Impaired Gas Exchange*	78	6.4	38.4	Ineffective Tissue Perfusion: Pulmonary	37	5.7	31.0	Ineffective Tissue Perfusion: Pulmonary	20	7.3	33.0
Impaired Skin Integrity*	71	5.8	44.2	Risk for Bleeding*	36	5.6	36.6	Impaired Gas Exchange*	18	6.6	39.6
Risk for Falls	63	5.2	49.4	Acute Pain*	30	4.7	41.2	Decreased Cardiac Output*	17	6.2	45.8
Deficient Knowledge Pre/Post Procedure/Surgery*	60	4.9	54.3	Risk for Falls	27	4.2	45.4	Risk for Impaired Skin Integrity*	17	6.2	52.0
Ineffective Tissue Perfusion: Pulmonary	60	4.9	59.2	Ineffective Breathing Pattern	27	4.2	49.6	Ineffective Tissue Perfusion: Cardiac*	14	5.1	57.1
Activity Intolerance	41	3.4	62.6	Deficient Knowledge, Disease Process	22	3.4	53.0	Risk for Falls	12	4.4	61.5
Impaired Physical Mobility*	36	3.0	65.6	Activity Intolerance	19	2.9	56.0	Activity Intolerance	11	4.0	65.6

*P<0.003, Acute Pain (X^2 = 63.1, p = 0.000); Impaired Gas Exchange (X^2 = 7.87, p = 0.020); Impaired Skin Integrity (X^2 = 40.6, p = 0.000); Deficient Knowledge Pre/Post Procedure/Surgery (X^2 = 39.7, p = 0.000); Impaired Physical Mobility (X^2 = 238, p = 0.000); Risk for Impaired Skin Integrity (X^2 = 155, p = 0.000) ; Deficient Knowledge, Disease Process (X^2 = 128, p = 0.000), Risk for Bleeding (X^2 = 42.5, p = 0.000) ; Decreased Cardiac Output (X^2 = 49.1, p = 0.000); Ineffective Tissue Perfusion: Cardiac (X^2 = 50.1, p = 0.000) and Ineffective Coping (X^2 =30.3, p = 0.000)

Note: The highlights are unique NANDA - I diagnoses in each unit.

Table 4.16 Comparison of the Most Frequently Used NIC interventions in Three ICUs

SICU (n = 2063)	n	%	Cum. %	MICU (n= 1083)	n	%	Cum.%	CVICU (n= 418)	n	%	Cum.%
Pain Management*	253	12.3	12.3	Ventilation Assistance*	91	8.4	8.4	Acid-Base Management	32	7.7	7.7
Fall Prevention	118	5.7	18.0	Acid-Base Management: Respiratory Acidosis*	64	5.9	14.3	Pain Management*	31	7.4	15.1
Skin Surveillance*	109	5.3	23.3	Airway Management	57	5.3	19.6	Cardiac Care, Acute*	31	7.4	22.5
Infection Protection	104	5.0	28.3	Airway Suctioning	57	5.3	24.8	Energy Management*	27	6.5	28.9
Ventilation Assistance*	100	4.8	33.2	Pain Management*	54	5.0	29.8	Teaching: Procedure/Treatment*	26	6.2	35.2
Infection Control	84	4.1	37.2	Fall Prevention	50	4.6	34.4	Teaching: Preoperative	22	5.3	40.4
Teaching: Procedure/Treatment*	84	4.1	41.3	Infection Protection	41	3.8	38.2	Ventilation Assistance	21	5.0	45.5
Airway Management	80	3.9	45.2	Acid-Base Management	41	3.8	42.0	Skin Surveillance*	20	4.8	50.2
Airway Suctioning	79	3.8	49.0	Infection Control	38	3.5	45.5	Airway Management	20	4.8	55.0
Acid-Base Management: Respiratory Acidosis*	78	3.8	52.8	Anxiety Reduction*	37	3.4	48.9	Acid-Base Management: Respiratory Acidosis*	19	4.5	59.6

*P<0.004, Pain Management (X^2 = 46.2, p =0.000) ; Skin Surveillance (X^2 = 44.9, p= 0.000) ; Ventilation Assistance (X^2 = 16.8, p = 0.000) ; Teaching: Procedure/Treatment (X^2 = 12.9, p = 0.002); Acid-Base Management (X^2 = 121, p = 0.000); Energy Management (X^2 = 27.7, p = 0.000) ; Anxiety Reduction (X^2 = 15.7; p =0.000); and Cardiac Care, Acute (X^2 = 120, p = 0.000)

Note: The highlights are unique NIC interventions in each unit.

Table 4.17 Comparison of the Most Frequently used NOC outcomes in Three ICUs

SICU				MICU				CVICU			
NOC (N =1340)	n	%	Cum.%	NOC (n=713)	n	%	Cum.%	NOC (n=292)	n	%	Cum.%
Pain Level*	211	15.7	15.7	Respiratory Status: Gas Exchange	70	9.8	9.8	Pain Level*	27	9.2	9.2
Tissue Integrity: Skin and Mucous Membranes*	107	8.0	23.7	Respiratory Status: Airway Patency	57	8.0	17.8	Knowledge: Treatment Procedure*	27	9.2	18.5
Infection Severity	97	7.2	30.9	Infection Severity	42	5.9	23.7	Tissue Integrity: Skin and Mucous Membranes	20	6.8	25.3
Respiratory Status: Gas Exchange	82	6.1	37.0	Pain Level*	38	5.3	29.0	Respiratory Status: Gas Exchange	20	6.8	32.2
Knowledge: Treatment Procedure*	80	6.0	43.0	Tissue Perfusion: Pulmonary	37	5.2	34.2	Respiratory Status: Airway Patency	20	6.8	39.0
Respiratory Status: Airway Patency	80	6.0	49.0	Blood Loss Severity*	36	5.0	39.3	Tissue perfusion: pulmonary	20	6.8	45.9
Knowledge: Fall Prevention	63	4.7	53.7	Respiratory Status: Ventilation	27	3.8	43.1	Cardiac Pump Effectiveness*	17	5.8	51.7
Tissue Perfusion: Pulmonary	60	4.5	58.2	Knowledge: Fall Prevention	26	3.6	46.7	Endurance*	16	5.5	57.2
Fall Prevention: Behavior	47	3.5	61.7	Fluid Balance*	26	3.6	50.4	Tissue Perfusion: Cardiac*	14	4.8	62.0
Activity Tolerance	39	2.9	64.6	Fall Prevention: Behavior	24	3.4	53.7	Knowledge: Fall Prevention	12	4.1	66.1

*P<0.003 (alpha = 0.05/16), Pain level (X^2 = 50.7, p =0.000); Tissue Integrity: Skin and Mucous Membranes (X^2 = 43.2, p =0.000); Blood Loss Severity (X^2 = 41.8, p =0.000); Cardiac Pump Effectiveness (X^2 = 55.5, p =0.000); Endurance (X^2 = 58.6, p =0.000); Fluid Balance (X^2 = 40.8, p =0.000); Tissue perfusion: cardiac (X^2 = 51.8, p =0.000); Knowledge: Treatment Procedure (X^2 = 16.4, p =0.000)

Note: The highlights are unique NOC outcomes in each unit.

Research Question Seven

Question 7 was to explore how patient characteristics (age and gender), clinical conditions (primary diagnoses and comorbidities), and nursing characteristics (the number of NANDA - I diagnosis, the type of ICU, and Nursing staff to Patient Ratio) differed according to changes in five NOC outcome scores based on Research question 2. The five most common NOC outcomes selected by ICU nurses are used for this question 7 and Question 8: *Pain Level*; *Respiratory Status: Gas Exchange*; *Respiratory Status: Airway Patency*; *Infection Severity*; and *Tissue Integrity: Skin and Mucous Membranes.*

Changes in NOC outcome scores were categorized into 3 groups: 'Declined', 'No change', and 'Improved'. Based on the change of NOC outcome score, patient characteristics, clinical conditions, and nursing characteristics were compared using a one-way analysis of variance (ANOVA) for continuous variables and a chi-square test for categorical variables. Among the primary diagnoses, acute cerebrovascular disease (CVD) and septicemia were selected as study variables because acute CVD was the most common disease in the group and septicemia was often referred to as a risk factor for poor patient outcomes in the ICUs.

Pain Level

For the NOC outcome, *Pain Level*, 276 patients were used for the analysis. The total sample was 56.9 % male and 44.1% female with a mean age of 56.99 years (SD=16.96, Range=18-96). Average ICU length of stay (LOS) for this group of patients was 62.25 hours (SD= 72.82), and 76.4% of the patients were admitted to the SICU. The patients had an average of 1.05 (SD=1.22) comorbidities and an average of 4.31 (SD = 2.84) NANDA - I diagnoses.

Table 4.18 and 4.19 display the results of ANOVA and chi-square analysis of variables related to the change of *Pain Level*'s score. In ANOVA analysis with continuous variables, there also were no significant differences in age at admission; comobidities; the number of NANDA - I diagnoses; and ICU length of stay among the three categories with the change of *Pain Level*'s score ($\alpha < 0.5$). However, the mean of ICU length of stay was significantly different among three categories of *Pain level*'s score with $p < 0.10$. The mean of ICU length of stay was significant higher in the group with decreased *Pain Level's* score (pain less controlled). In addition, in chi-square analysis with categorical variables, the change in the NOC outcome score differed significantly depending on whether the patient was male or female with $p < 0.10$.

Table 4.18 The Association between the Changes in *Pain Level* Scores and Continuous Study Variables

		N	Mean	SD[3]	Min.[1]	Max.[2]	*F*	p
Comorbidity	Declined	44	.89	1.04	0	4	0.49	0.61
	No change	152	1.09	1.25	0	6		
	Improved	80	1.09	1.26	0	5		
	Total	276	1.05	1.22	0	6		
Number of NANDA - I Diagnoses	Declined	44	4.27	2.71	1	13	0.01	0.99
	No change	152	4.30	2.83	1	16		
	Improved	80	4.35	2.95	1	16		
	Total	276	4.31	2.84	1	16		
Age at Admission	Declined	44	54.14	18.54	18	96	1.41	0.25
	No change	152	58.46	16.93	20	89		
	Improved	80	55.75	16.01	19	87		
	Total	276	56.99	16.96	18	96		
ICU Length of Stay (hours)	Declined	44	81.62	78.77	5.18	420.97	2.68	0.07
	No change	152	54.20	63.96	2.03	397.77		
	Improved	80	66.90	83.10	11.95	682.73		
	Total	276	62.25	72.82	2.03	682.73		
Skill Mix of Nursing Caregivers	Declined	44	0.89	0.31	0.83	0.86	0.66	0.52
	No change	152	0.88	0.41	0.74	1.00		
	Improved	79	0.88	0.41	0.75	0.97		
	Total	276	0.88	0.04	0.74	1.00		

[1]Minimum [2]Maximum [3]Standard Deviation

Table 4.19 The Association between the Change of *Pain Level* Scores and Categorical Study Variables

Variables		The change of NOC score				X^2	p
		Declined	No change	Improved	Total		
Gender	Female	25	58	36	119	5.008	.082
		56.8%	38.2%	45.0%	43.1%		
	Male	19	94	44	157		
		43.2%	61.8%	55.0%	56.9%		
	Total	44	152	80	276		
		100.0%	100.0%	100.0%	100.0%		
Acute CVD	Yes	7	17	6	30	2.107	.349
		23.3%	56.7%	20.0%	100.0%		
	No	37	135	74	246		
		15.0%	54.9%	30.1%	100.0%		
	Total	44	152	80	276		
		15.9%	55.1%	29.0%	100.0%		
Septicemia	Yes	1	9	7	17	2.094	.351
		5.9%	52.9%	41.2%	100.0%		
	No	43	143	73	259		
		16.6%	55.2%	28.2%	100.0%		
	Total	44	152	80	276		
		15.9%	55.1%	29.0%	100.0%		
ICU Type	SICU	36	118	57	211	4.443	.349
		17.1%	55.9%	27.0%	100.0%		
	MICU	5	17	16	38		
		13.2%	44.7%	42.1%	100.0%		
	CVICU	3	17	7	27		
		11.1%	63.0%	25.9%	100.0%		
	Total	44	152	80	276		
		15.9%	55.1%	29.0%	100.0%		
Nursing Staff to Patient Ratio	<=1:1	0	2	1	3	0.648	.958
		0%	66.7%	33.3%	100.0%		
	1:1-1:1.5	38	128	66	232		
		16.4%	55.2%	28.4%	100.0%		
	>1:1.5	6	22	12	40		
		15.0%	55.0%	30.0%	100.0%		
	Total	44	152	79	275		
		16.0%	55.3%	28.7%	100.0%		

Respiratory Status: Gas Exchange

One hundred and seventy two patients were rated for the outcome *Respiratory Status: Gas Exchange*. The patients included 104 males (65.4%) with a mean age of 55.93 (SD = 60.67, Range = 19 – 90). They had an average of 1.21 (SD =2.56) comorbidities and 5.48 (SD=2.61) NANDA - I diagnoses. Twelve percent of the patients' status declined at the time of the last rating for the ICU stay, while 43% improved at the last rating.

Table 4.20 and Table 4.21 present the relationship between the study variables and the change score of the NOC outcome *Respiratory Status: Gas Exchange.* The mean age differed significantly among the change of *Respiratory Status: Gas Exchange'*s score groups (F=4.416, p=0.014). The mean for ICU length of stay in the sample was 118.54 hours (SD=123.99, Range =6.42 – 738.50). There was a significant difference in ICU length of stay among the three categories in relation to the change of *Respiratory Status: Gas Exchange'*s score (F=13.92, p=0.000). The mean ICU length of stay in hours for the patient's whose outcome score decreased was higher than in the other two groups. The mean of age at admission also significantly differed among three categories with the change of the NOC outcome score. Except ICU LOS and age, there were no significant differences among the changes in the NOC outcome scores based on variables in the study.

Table 4.20 The Association between the Changes in *Respiratory Status: Gas Exchange* Scores and Continuous Study Variables

		N	Mean	SD[3]	Min.[1]	Max.[2]	*F*	p
Comorbidity	Declined	20	1.20	1.20	0	3	.184	.832
	No change	78	1.27	1.32	0	7		
	Improved	74	1.15	1.13	0	4		
	Total	172	1.21	1.22	0	7		
Number of NANDA - I Diagnoses	Declined	20	5.85	2.56	1	12	3.562	.031
	No change	78	4.91	2.43	1	13		
	Improved	74	5.99	2.71	2	16		
	Total	172	5.48	2.61	1	16		
Age at Admission	Declined	20	52.55	15.00	28	80	4.416	.014
	No change	78	61.97	15.95	21	90		
	Improved	74	55.99	15.04	19	85		
	Total	172	58.30	15.76	19	90		
ICU Length of Stay (hours)	Declined	20	201.20	176.31	6.42	738.50	11.392	.000
	No change	78	76.29	71.73	11.08	287.47		
	Improved	74	140.74	134.97	20.33	682.73		
	Total	172	118.54	123.99	6.42	738.50		
Skill Mix of Nursing Caregivers	Declined	20	0.90	0.04	.80	.95	.252	.778
	No change	78	0.90	0.03	.80	.97		
	Improved	74	0.90	0.04	.79	.97		
	Total	172	0.90	0.04	.79	.97		

[1]Minimum [2]Maximum [3]Standard Deviation

Table 4.21 The Association between the Change of *Respiratory Status: Gas Exchange* Scores and Categorical Study Variables

		The change of NOC score					
		Declined	No change	Improved	Total	X^2	p
Gender	Female	7 35.00%	29 37.20%	32 43.20%	68 39.50%	0.779	.677
	Male	13 65.00%	49 62.80%	42 56.80%	104 60.50%		
	Total	20 100.00%	78 100.00%	74 100.00%	172 100.00%		
Acute CVD	No	19 95.00%	66 84.60%	67 90.50%	152 88.40%	0.779	0.677
	Yes	1 5.00%	12 15.40%	7 9.50%	20 11.60%		
	Total	20 100.00%	78 100.00%	74 100.00%	172 100.00%		
Septicemia	No	19 95.00%	72 92.30%	67 90.50%	158 91.90%	0.457	.796
	Yes	1 5.00%	6 7.70%	7 9.50%	14 8.10%		
	Total	20 100.00%	78 100.00%	74 100.00%	172 100.00%		
Nursing Staff to Pt Ratio	1:1-1:1.5	19 95.00%	75 96.20%	68 91.90%	162 94.20%	1.287	.525
	>1:1.5	1 5.00%	3 3.80%	6 8.10%	10 5.80%		
	Total	20 100.00%	78 100.00%	74 100.00%	172 100.00%		
ICU Type	SICU	11 55.00%	35 44.90%	36 48.60%	82 47.70%	3.792	.435
	MICU	9 45.00%	31 39.70%	30 40.50%	70 40.70%		
	CVICU	0 0.00%	12 15.40%	8 10.80%	20 11.60%		
	Total	20 100.00%	78 100.00%	74 100.00%	172 100.00%		

Respiratory Status: Airway Patency

For the outcome Respiratory Status: Airway Patency, 157 patients were included in the analysis. The mean age of patients with this outcome was 57.83 years (SD=15.94, Range=19 – 90), and more than half were male (60 %). The length of stay in the ICU averaged 119.81 hours (SD=122.03, Range =6.42 – 738.50), and 51% of patients were admitted to SICU. The patients had an average of 5.61(SD=2.57) NANDA - I diagnoses and 1.21 (SD= 1.18) comobidities. The score for *Respiratory Status: Airway Patency* increased in 47.14 % patients and decreased in 12.74% patients over the ICU stay.

The number of NANDA - I diagnoses (F=4.14, p = 0.18) and ICU length of stay (F= 4.02, p = 0.02) significantly differed among three categories with the change of Respiratory *Status; Airway Patency* score at a 0.05 alpha level. Patients with poorer NOC outcome scores had more NANDA - I diagnoses and longer ICU lengths of stay. However, there were no significant differences in age, gender, comorbidities, primary medical diseases, type of ICU, nursing staff to patient ratio, and skill mix of nursing caregivers among the changes in the NOC outcome scores. Table 4.22 and Table 4.23 show these relationships between the study variables and the changes in the NOC outcome score.

Table 4.22 The Association between the Changes in *Respiratory Status: Airway Patency* Scores and Continuous Study Variables

		N	Mean	SD[3]	Min.[1]	Max.[2]	*F*	p
Comorbidity	Declined	20	1.40	1.27	0	4	.421	.657
	No change	63	1.13	1.02	0	4		
	Improved	74	1.23	1.30	0	5		
	Total	157	1.21	1.18	0	5		
Number of NANDA - I Diagnoses	Declined	20	5.00	1.56	3	8	4.135	.018
	No change	63	5.08	2.07	1	10		
	Improved	74	6.22	3.03	2	16		
	Total	157	5.61	2.57	1	16		
Age at Admission	Declined	20	57.90	14.82	30	85	.269	.764
	No change	63	56.73	17.70	19	90		
	Improved	74	58.74	14.75	26	87		
	Total	157	57.83	15.94	19	90		
ICU Length of Stay (hours)	Declined	20	182.81	182.71	23.15	738.50	4.021	.020
	No change	63	96.18	117.58	6.42	682.73		
	Improved	74	122.90	99.05	22.15	503.42		
	Total	157	119.81	122.03	6.42	738.50		
Skill Mix of Nursing Caregivers	Declined	20	0.91	0.03	0.85	0.96	.666	.515
	No change	63	0.90	0.04	0.80	0.98		
	Improved	74	0.90	0.04	0.79	0.97		
	Total	157	0.90	0.04	0.79	0.98		

[1]Minimum [2]Maximum [3]Standard Deviation

Table 4.23 The Association between the Change of *Respiratory Status: Airway Patency* Scores and Categorical Study Variables

Variables		The Change of NOC score				X^2	p
		Declined	No change	Improved	Total		
Gender	Female	8	27	32	67	0.069	.966
	N (%)	40.0%	42.9%	43.2%	42.7%		
	Male	12	36	42	90		
	N (%)	60.0%	57.1%	56.8%	57.3%		
	Total	20	63	74	157		
		100.0%	100.0%	100.0%	100.0%		
Acute CVD	No	17	53	68	138	2.11	.348
		85.0%	84.1%	91.9%	87.9%		
	Yes	3	10	6	19		
		15.0%	15.9%	8.1%	12.1%		
	Total	20	63	74	157		
		100.0%	100.0%	100.0%	100.0%		
Septicemia	No	18	59	66	143	0.867	.648
		90.0%	93.7%	89.2%	91.1%		
	Yes	2	4	8	14		
		10.0%	6.3%	10.8%	8.9%		
	Total	20	63	74	157		
		100.0%	100.0%	100.0%	100.0%		
Type of ICU	SICU	9	32	39	80	2.726	.605
		45.0%	50.8%	52.7%	51.0%		
	MICU	10	23	24	57		
		50.0%	36.5%	32.4%	36.3%		
	CVICU	1	8	11	20		
		5.0%	12.7%	14.9%	12.7%		
	Total	20	63	74	157		
		100.0%	100.0%	100.0%	100.0%		
Nursing Staff to Patient Ratio	1:1 - 1:1.5	19	57	70	146	1.027	.598
		95.0%	90.5%	94.6%	93.0%		
	>1:1.5	1	6	4	11		
		5.0%	9.5%	5.4%	7.0%		
	Total	20	63	74	157		
		100.0%	100.0%	100.0%	100.0%		

Infection Severity

A total of 147 patients with the NOC outcome *Infection Severity* were used for the analysis. The patient sample included 92 males (62.6%) and 55 females (37.4%) with a mean age of 57.24 years (SD = 17.19, Range =18-89). They had an average of 1.01 comorbidities (SD=1.24) and 5.02 NANDA- I diagnoses (SD=2.87). The mean ICU length of stay for patients with this outcome was 75.72 hours (SD=94.68, Range=7.70 - 682.73) and 66% of the patients were admitted to the SICU.

The *Infection Severity* scores of 18.4% of the patients decreased over their ICU stay, while the scores of 40.0% of patients increased. The nursing caregiver skill mix (F =3.50, p = 0.033) and the number of NANDA- I diagnoses (F= 3.31, p = 0.39) significantly differ among the three categories with the change of *Infection Severity* score at the 0.05 alpha level. The mean number of NANDA - I diagnoses was significantly higher in patients with poorer scores on *Infection Severity*. The rate of nursing caregiver skill mix was lower in the "No change" group for this outcome (Table 4.24)

ICU length of stay (LOS) was significantly different by the change of *Infection Severity* score at the 0.10 alpha level (F= 3.497, p = 0.33). The mean of ICU LOS was significantly longer in the group with poorer *Infection Severity* scores (Table 23). In addition, there was a significant difference in the change of *Infection Severity* scores among the type of ICUs with 0.10 alpha level (X^2 = 8.614, p= 0.072) (Table 24). In other words, there was a significant relationship between the type of ICUs and the change of *Infection Severity* scores. However, there were no significant differences in *Infection Severity* scores in relation to the other study variables (age, gender, comorbidities, primary diseases, and nursing staff to patient ratio). Table 4.24 and Table 4.25 summarize the results of these analyses.

Table 4.24 The Association between the Changes in *Infection Severity* Scores and Continuous Study Variables

		N	Mean	SD[3]	Min.[1]	Max.[2]	*F*	p
Comorbidity	Declined	27	.85	1.20	0	5	1.056	.351
	No change	80	1.15	1.34	0	6		
	Improved	40	.85	1.05	0	4		
	Total	147	1.01	1.24	0	6		
Number of NANDA - I Diagnoses	Declined	27	6.19	3.76	2	16	3.309	.039
	No change	80	4.58	2.06	1	10		
	Improved	40	5.13	3.39	1	14		
	Total	147	5.02	2.87	1	16		
Age at Admission	Declined	27	58.48	15.35	29	89	.762	.469
	No change	80	58.25	17.57	19	89		
	Improved	40	54.38	17.65	18	82		
	Total	147	57.24	17.19	18	89		
ICU Length of Stay (hours)	Declined	27	106.72	111.14	13.40	420.97	2.564	.081
	No change	80	61.33	92.80	7.70	682.73		
	Improved	40	83.58	81.98	12.28	287.47		
	Total	147	75.72	94.68	7.70	682.73		
Skill Mix of Nursing Caregivers	Declined	27	0.90	0.03	0.83	0.97	3.497	.033
	No change	80	0.88	0.04	0.75	0.97		
	Improved	40	0.90	0.04	0.80	0.97		
	Total	147	0.89	0.04	0.75	0.97		

[1]Minimum [2]Maximum [3]Standard Deviation

Table 4.25 The Association between Change of *Infection Severity* Scores and Categorical Study Variables

Variables		The change of NOC score				X^2	p
		Declined	No change	Improved	Total		
Gender	Female	9 33.3%	33 41.3%	13 32.5%	55 37.4%	1.107	.575
	Male	18 66.7%	47 58.8%	27 67.5%	92 62.6%		
	Total	27 100.0%	80 100.0%	40 100.0%	147 100.0%		
Acute CVD	No	26 96.3%	76 95.0%	37 92.5%	139 94.6%	0.518	.772
	Yes	1 3.7%	4 5.0%	3 7.5%	8 5.4%		
	Total	27 100.0%	80 100.0%	40 100.0%	147 100.0%		
Septicemia	No	26 96.3%	74 92.5%	34 85.0%	134 91.2%	2.945	.229
	Yes	1 3.7%	6 7.5%	6 15.0%	13 8.8%		
	Total	27 100.0%	80 100.0%	40 100.0%	147 100.0%		
Type of ICU	SICU	18 66.7%	58 72.5%	21 52.5%	97 66.0%	8.614	.072
	MICU	9 33.3%	19 23.8%	14 35.0%	42 28.6%		
	CVICU	0 .0%	3 3.8%	5 12.5%	8 5.4%		
	Total	27 100.0%	80 100.0%	40 100.0%	147 100.0%		
Nursing Staff to Patient Ratio	<=1:1	0 .0%	2 2.5%	0 .0%	2 1.4%	1.835	.766
	1:1-1:1.5	24 88.9%	70 87.5%	35 87.5%	129 87.8%		
	>1:1.5	3 11.1%	8 10.0%	5 12.5%	16 10.9%		
	Total	27 100.0%	80 100.0%	40 100.0%	147 100.0%		

Tissue Integrity: Skin and Mucous Membranes

For this outcome 134 patients were used for the analysis. The mean age of the patients was 59.22 years (SD = 16.3), and 61.2% of the patients were male. They had an average of 1.16 comorbidities (SD=1.28) and 5.60 NANDA- I diagnoses (SD=3.11). The mean of ICU length of stay was 86.03 hours (SD=111.36), and 79.9% of the patients were admitted to SICU.

For the change of *Tissue Integrity: Skin and Mucous Membranes* score, 20.15% of patients were in the category of 'Declined'; 58.96% in 'No change'; and 20.90% in 'Improved'. Table 4.26 and Table 4.27 show the change of *Tissue Integrity: Skin and Mucous Membranes* scores by study variables. Only ICU length of stay was significantly different in relation to the change of the NOC outcome score with a 0.05 alpha level. The mean of ICU length of stay was significantly higher in the group with poorer NOC outcome scores (F=3.983, p = 0.021). With a 0.10 alpha level, the change of the NOC outcome score was significantly different between the patients with septicemia and the patients without septicemia (X^2 = 5.495, p=0. 064).

Table 4.26 The Association between the Changes in *Tissue Integrity: Skin and Mucous Membranes* Scores and Continuous Study Variables

		N	Mean	SD[3]	Min.[1]	Max.[2]	*F*	p
Comorbidity	Declined	27	1.30	1.07	0	4	.260	.772
	No change	79	1.10	1.26	0	4		
	Improved	28	1.21	1.52	0	6		
	Total	134	1.16	1.28	0	6		
Number of NANDA - I Diagnoses	Declined	27	5.70	3.14	2	14	.320	.727
	No change	79	5.43	2.60	2	16		
	Improved	28	5.96	4.32	1	16		
	Total	134	5.60	3.11	1	16		
Age at Admission	Declined	27	61.81	17.38	19	88	.472	.625
	No change	79	58.27	15.87	20	96		
	Improved	28	59.39	17.05	24	87		
	Total	134	59.22	16.36	19	96		
ICU Length of Stay (hours)	Declined	27	138.75	186.44	16.70	738.50	3.983	.021
	No change	79	71.34	81.32	11.95	420.97		
	Improved	28	76.65	70.74	15.98	267.32		
	Total	134	86.03	111.36	11.95	738.50		
Skill Mix of Nursing Caregivers	Declined	27	0.88	0.03	0.80	0.94	.383	.683
	No change	78	0.88	0.03	0.79	0.97		
	Improved	28	0.88	0.03	0.79	0.95		
	Total	133	0.88	0.03	0.79	0.97		

[1]Minimum [2]Maximum [3]Standard Deviation

Table 4.27 The Association between the Change of *Tissue Integrity: Skin and Mucous Membranes Scores* and Categorical Study Variables

Variables		Change of NOC score				X^2	p
		Declined	No change	Improved	Total		
Gender	Female	8	31	13	52	1.649	.439
		29.6%	39.2%	46.4%	38.8%		
	Male	19	48	15	82		
		70.4%	60.8%	53.6%	61.2%		
	Total	27	79	28	134		
		100.0%	100.0%	100.0%	100.0%		
Acute CVD	No	26	74	25	125	1.124	.570
		96.3%	93.7%	89.3%	93.3%		
	Yes	1	5	3	9		
		3.7%	6.3%	10.7%	6.7%		
	Total	27	79	28	134		
		100.0%	100.0%	100.0%	100.0%		
Septicemia	No	24	77	28	129	5.495	.064
		88.9%	97.5%	100.0%	96.3%		
	Yes	3	2	0	5		
		11.1%	2.5%	.0%	3.7%		
	Total	27	79	28	134		
		100.0%	100.0%	100.0%	100.0%		
Type of ICU	SICU	22	63	22	107	0.68	.954
		81.5%	79.7%	78.6%	79.9%		
	MICU	1	5	1	7		
		3.7%	6.3%	3.6%	5.2%		
	CVICU	4	11	5	20		
		14.8%	13.9%	17.9%	14.9%		
	Total	27	79	28	134		
		100.0%	100.0%	100.0%	100.0%		
Nursing Staff to Patient Ratio	1:1-1:1.5	25	72	27	124	0.577	.750
		92.6%	92.3%	96.4%	93.2%		
	>1:1.5	2	6	1	9		
		7.4%	7.7%	3.6%	6.8%		
	Total	27	78	28	133		
		100.0%	100.0%	100.0%	100.0%		

Research Question Eight

Question 8 was to determine the unique effect of study variables (age, gender, ICU length of stay, primary medical diagnosis, co-morbidities, the number of NANDA - I diagnoses, nursing caregiver skill mix, nursing staff to patient ratio, and ICU type) on the change score while controlling potential confounding factors. Clinically relevant variables yielding $p<.30$ in research question 7 were entered into multinomial logistic regression models. Multinomial logistic regression models were tested using a $p <.05$ significance level and the reference as "No change".

Pain Level

Age, gender, and ICU length of stay were included in the multinomial logistic regression model to determine the effect on the change of *Pain Level* score. Table 4.28 shows the results of the analysis. ICU length of stay and gender significantly influenced the change of *Pain Level* score at the 0.05 alpha level. As ICU length of stay increased, so did the likelihood of a decrease in the *Pain Level* score (If ICU length of stay was increased by one unit, the odds for the decrease in *Pain Level* score to no change of Pain Level score would be expected to increase by a factor of 1.01 given the other variables in the model were held constant). The *Pain Level* score was more likely to be declined (less controlled) among females than among males. (For females, the odds for the decrease in Pain Level score to no change in Pain level would be expected to be 2.352 times greater than males given the other variables in the model are held constant).

Table 4.28 Multinomial Logistic Regression of Relevant Variables on the Change of *Pain Level* Score

	The change of *Pain Level* score					
	Declined[a]			Improved[a]		
	OR[1]	95% CI[2]	p	OR	95% CI	p
Age	0.986	0.966 -1.006	0.162	0.990	0.974- 1.006	0.238
Gender						
Female	2.352	1.170 - 4.726	0.016	1.378	0.792 - 2.397	0.257
ICU LOS	1.005	1.001-1.010	0.024	1.003	0.999 -1.007	0.147

a. The reference category is: No change.

[1]Odds Ratio; [2]Confidence Interval

Likelihood Ratio Tests X^2= 13.59, p=0.035; Cox and Snell pseudo R^2= 0.048.

Respiratory Status: Gas Exchange

Age, ICU length of stay, and the number of NANDA - I diagnoses were entered into the multinomial logistic regression model to determine the independent effect of the variables on the change of Respiratory Status: Gas Exchange score. Table 4.29 presents the results. Age and ICU length of stay were statistically significant in the model. For a one unit increase of age, the odds of having a decrease of the NOC outcome score to no change of the NOC outcome score were 0.96 times at a given age. The odds of having an increase of the NOC outcome score to no change of the NOC outcome score were also 0.97 times for each one unit increase of age. Generally speaking, as age increased, the likelihood of the decrease of the NOC outcome score to the no change of the score was decreased, and the likelihood of the increase of the score to the no change of the score was also decreased. In addition, as ICU length of stay increased, so did the likelihood of the decrease of the NOC outcome scores (OR=1.009, p=0.001) and the increase of the NOC outcomes scores (OR=1.006, p= 0.006).

Table 4.29 Multinomial Logistic Regression of Relevant Variables on the Change of *Respiratory Status: Gas Exchange* Score

	The change of *Respiratory Status: Gas Exchange* score					
	Declined[a]			Improved[a]		
	OR	95% CI	p	OR	95% CI	p
# of NANDA - I Diagnoses	1.035	0.829-1.293	0.761	1.101	0.956-1.268	0.180
Age	0.965	0.933-0.998	0.040	0.975	0.953-0.997	0.028
ICU LOS	1.009	1.004-1.014	0.001	1.006	1.002-1.011	0.006

a. The reference category is: No change.

[1]Odds Ratio; [2]Confidence Interval

Likelihood Ratio Tests X^2= 31.787, p<0.001; Cox and Snell pseudo R^2= 0.169.

Respiratory Status: Airway Patency

Table 4.30 shows the results of the multinomial logistic regression with two variables for *Respiratory Status: Airway Patency*. ICU length of stay on the decrease in the NOC outcome and the number of NANDA - I diagnoses on the increase of the outcome were statistically significant. As ICU length of stay increased, the odds of the decrease of *Respiratory Status: Airway Patency* score to the no change of the outcome score was 1.005 times higher for each one hour increase of ICU length of stay (OR = 1.005, p= 0.010). The greater the numbers of NANDA - I diagnoses a patient has, the more likely the patient is to have increase in the NOC outcome scores compared to no change (OR =1.179, p=0.033).

Table 4.30 Multinomial Logistic Regression of Relevant Variables on the Change of *Respiratory Status: Airway Patency* Scores

	The change of *Respiratory Status: Gas Exchange* score					
	Declined[a]			Improved[a]		
	OR[1]	95% CI[2]	p	OR	95% CI	p
# of NANDA - I Diagnoses	.875	.667 - 1.148	.335	1.179	1.014 - 1.371	.033
ICU LOS (Hours)	1.005	1.001- 1.010	.010	1.001	.998 - 1.005	.457

a. The reference category is: No change.

[1]Odds Ratio; [2]Confidence Interval

Likelihood Ratio Tests X^2= 15.888, p=0.003; Cox and Snell pseudo R^2= 0.096.

Infection Severity

The number of NANDA - I diagnoses, ICU length of stay, ICU types, and septicemia were entered into the multinomial logistic regression model to determine the effect of the variables on the change of *Infection Severity* score. Only the number of NANDA - I diagnoses was statistically significant in the model. As the number of NANDA - I diagnoses increased, the likelihood of the decrease of *Infection Severity* score to no change of Infection severity score was increased 1.178 times (OR = 1.178, p=0.045). In addition, patients who admitted to the SICU were 0.204 times as likely (about half as likely) to be in the "Decreased" group verse the "No change" in *Infection Severity* Scores compared to patients who admitted to the CVICU (OR = 0.204, p=0.043).

Table 4.31 Multinomial Logistic Regression of Relevant Variables on the Change of *Infection Severity* Scores

	The change of *Infection severity* score					
	Declined[a]			Improved[a]		
	OR	95% CI	p	OR[1]	95% CI[2]	p
ICU LOS	0.99	0.98- 1.01	0.316	1.002	0.997 -1.007	0.384
# of NANDA -I Dx	1.178	1.004-1.381	0.045	1.101	0.939-1.291	238
Septicemia No[b]	3.452	0.343-34.747	0.293	0.61	0.1444-2.582	0.502
ICU type[c]						
SICU	.204	0.044-0.952	.043	1.18	0.46 -3.03	0.734
MICU	.414	0.31- 7.78	.309	2.18	0.71- 6.73	0.175

[1]Odds Ratio; [2]Confidence Interval

[a] The reference category is: No change; [b] The reference category is: Yes; [c] The reference category is: CVICU

Likelihood Ratio Tests X^2= 21.587, p=0017; Cox and Snell pseudo R^2= 0.137

Tissue Integrity: Skin and Mucous Membranes

ICU length of stay and septicemia were entered into the multinomial logistic regression model to determine the effect of the variables on the change of *Tissue Integrity: Skin and Mucous Membranes* score. As ICU length of stay increased, so did the likelihood of the decrease of the NOC outcome score (If ICU length of stay was increased by one unit, the odds for the decrease in the NOC outcome score would be expected to increase by a factor of 1.004 given the other variables in the model were held constant (OR=1.004, p=0.042).

Table 32 Multinomial Logistic Regression of Relevant Variables on the Change of *Tissue Integrity: Skin and Mucous Membranes* Scores

	The change of *Tissue Integrity: Skin and Mucous Membranes* score					
	Declined[a]			Improved[a]		
	OR	95% CI	p	OR	95% CI	p
Septicemia(no)	0.290	0.040-2.109	0.221	4283748.712	4283748.712	.
ICU LOS	1.004	1.000-1.008	0.042	1.001	0.996-1.006	0.737

a. The reference category is: No change.

[1]Odds Ratio; [2]Confidence Interval

Likelihood Ratio Tests X^2= 9.962, p=0.041; Cox and Snell pseudo R^2= 0.072

Summary

This chapter described the results of statistical analyses for the 8 research questions. The questions were addressed in a sample of 578 ICU patients. Data were analyzed using frequency, one-way ANOVA, and multinomial logistic regression. Eight NANDA - I diagnoses, 79 NOC outcomes, and 90 NIC interventions were identified in the nursing care plans in the health information system. *Acute Pain - Pain Level - Pain Management* was the most frequently used NNN linkage followed by *Impaired Gas Exchange-Respiratory Status: Airway Patency-Acidosis*. The similarities and differences of three nursing languages used in each ICU were examined. In addition, the difference between the practical use of three languages in ICU nursing care plans and core interventions and outcomes for critical care nursing suggested by experts were examined. Lastly, the influence of study variables related to patient characteristics, clinical conditions, and nursing characteristics on the changes in five common NOC outcome

scores were analyzed: *Pain Level*, *Respiratory Status: Gas Exchange*, *Respiratory: Airway Patency*, *Infection Severity*, and *Tissue Integrity: Skin and Mucous Membranes.*

CHAPTER V

DISCUSSION AND CONCLUSION

This retrospective descriptive study is the first study to identify nursing practice in a specialty area, critical care nursing, using clinical data from a hospital data warehouse. The focus of the research was to analyze the administrative data and nursing care plan data of 578 patents admitted to 3 ICUs during 2 months. The findings showed the actual use of nursing diagnoses, nursing outcomes, and nursing interventions in nursing care plans for ICU patient care. In this chapter, the meaningful results of this study are discussed as well as how we can apply these results in clinical practice, education, and research. In addition, the study limitations are described.

The Characteristics of ICU Patients

Because of the aging U.S. population, the mean age of patients admitted to ICUs is rising and the number of individuals age 65 and older is dramatically increasing (Angus et al., 2000). However, the mean age of the 578 ICU patients in this study (M=56.52, SD=17.91) was lower than the mean age of patients admitted to ICUs in the U.S. In particular, the number of patients 85 years and older (5.2%) in this study was lower than expected when compared to statistics of an average (6.9%) found in the overall of U.S. population. As primary medical diagnoses, acute cerebralvascular diseases, septicemia, and gastrointenstinal hemorrhage were the most common admitting medical diagnoses for patients in this study. These diseases are considered as common primary ICU admitting diagnoses.

The average ICU length of stay (LOS) for patients in the American Association of Critical-Care Nurses' national survey ranged from 2 to 5 days (Kirchhoff & Dahl, 2006). The ICU length of stay in this study (M= 2.68 days) was within the range. However,

while ICU length of stay for Medicare patients was 4.36 days, the ICU length of stay in this study was shorter and was similar to mean floor LOS for critical care beds not ICUs (about 2 days) of Medicare patients (Milbrandt et al., 2008). Nursing staff to patient ratio was lower than the average of ICUs in other studies. The skill mix of nursing caregivers, which shows the rate of RNs, was higher than other studies, and most nursing staff who provided nursing care to patients were RNs (M = 0.90, SD=0.13)(Needleman, Buerhaus, Stewart, Zelevinsky, & Mattke, 2006). Because ICU nurses need very specialized skills and knowledge to care for ICU patients, the hospital seems to hire more RNs compared to other units.

NANDA - I Diagnoses, NOC Outcomes, and NIC Interventions (NNN) Used in ICU Nursing Care Plans

An average of 3.69 NANDA - I diagnoses, 4.06 NOC outcomes, and 5.98 NIC interventions per patient were identified over the patients' ICU stay. These numbers are smaller than those found in studies with other patient groups. In Scherb's study (2001) with patients having pneumonia, heart failure, or total hip joint replacement, the patient had an average of 10 NANDA - I diagnoses, 10 NOC outcomes, and 20 NIC interventions (Scherb, 2001). Park (2010)'s recent study with heart failure (HF) patients showed each patient had an average of 5 NANDA - I diagnoses, 8 NOC outcomes, and 11 NIC interventions (Park, 2010). One of reasons that the patients had fewer NNN could be relatively short ICU stays when compared to lists of diagnoses, outcomes and interventions for the entire hospitalization. In addition, the pool of available nursing care plans from which ICU nurses selected NNNs in the health information system might limited compared with other hospitals.

NANDA - I Diagnoses

Eighty one NANDA - I diagnoses were identified from nursing care plans of the ICU patients for the 3 ICUs. Seven of the 10 most common NANDA - I diagnoses (60.7% of the total of NANDA - I diagnoses) reflected actual problems and three described potential problems with the term "Risk for." The domains of these 10 NANDA - I diagnoses consisted of 4 from Safety/Protection, 2 from Activity/Rest, 2 from Perception/Cognition, 1 from Comfort, and 1 from Elimination and Exchange. These represented 5 domains from the total of 13 domains in the NANDA - I Taxonomy.

Impaired Gas Exchange, Ineffective Airway Clearance, Impaired Skin Integrity, Potential (Risk) for Infection, which were among the 10 most common NANDA - I diagnoses of this study, were selected as high frequency, high priority diagnoses by critical care nurses in previous studies (Kuhn, 1991b; Wieseke et al., 1994). These identified nursing diagnoses were similar to an analysis of nursing diagnoses in a Brazilian ICU. In both studies the nursing diagnoses were focused more on psychobiological problems than on psychosocial or psychospiritual problems (de Fatima Lucena & de Barros, 2006). Even though the order of the frequencies was a little different, the most common nursing diagnoses used in nursing care plans of hospitalized HF patients were also similar to the results of this study (Park, 2010; Scherb, 2001). However, NANDA - I diagnoses of this study were different from those that Lunney (2004) found in school nurses' documentation. The NANDA - I diagnoses in school nurses' documentation were more related to health promotions such as *Health-Seeking Behaviors and Self-Concept, Readiness for Enhanced* (Lunney, 2006b). This is what one

would expect given the vast difference in the school environment compared to care provided in ICUs of acute care hospitals.

The comparison of the ten NANDA - I diagnoses most frequently used in each unit showed the difference according to the characteristics of patients in the ICUs. Even though six NANDA- I diagnoses (38%) were identical among all three ICUs, two (*Acute Pain* and *Impaired Gas Exchange*) of them had significantly different proportions among the three ICUs. *Acute Pain* was the most frequently used in the SICU and the CVICU but was ranked 6th in the MICU. This result is reasonable because the postoperative pain of SICU or CVICU patients is considered to be an important assessment to prevent postoperative pulmonary complications (Cullen, Greiner, & Titler, 2001). While *Impaired Gas Exchange* was the most frequently used in the care plans of the MICU, it was ranked 3rd and 4th in the SICU and the CVICU. In addition, each ICU unit had unique nursing diagnoses: *Impaired Skin Integrity* and *Impaired Physical Mobility* for the SICU, *Risk for Bleeding, Ineffective Breathing Pattern*, and *Deficient Knowledge* for the MICU, and *Risk for Impaired Skin Integrity*, and *Ineffective Tissue Perfusion: Cardiac* for CVICU. While nursing diagnoses used in the SICU were more focused on physical comfort or the activity of patients, nursing diagnoses used in the MICU were more focused on respiratory function or cardiovascular/ pulmonary function. Nursing diagnoses in the CVICU mainly dealt with cardiovascular/pulmonary function. Interestingly, the unique diagnoses in the SICU were also highly ranked for the patients who had a Total Hip Replacement (THR) in Scherb's (2001) study; the unique items of the CVICU were highly also ranked highly for the patients with Congestive Heart Failure (CHF) (Scherb, 2001).

NIC Interventions

Among 79 NIC interventions, the ten most commonly used nursing interventions for ICU nursing care were related to physiological management. The domains of the top ten NIC interventions used in the nursing care plans were from 6 different domains: 7 from the Physiological: Complex Domain (*Ventilation Assistance, Acid-Base Management: Respiratory Acidosis, Airway Management, Airway Suctioning, Acid-Base Management,* and *Skin Surveillance*): 2 from the Safety Domain (*Fall Prevention* and *Infection Control*), 1 from the Domain Physiological: Basic (Pain Management), and 1 from the Behavioral Domain (*Teaching: Procedure/Treatment*). In particular, among nursing interventions in the Physiological Domain, four NIC interventions were in the Class of Respiratory Management. Compared with NIC interventions used in other patient groups, the NIC interventions related to respiratory management were more prevalent in ICU settings (Dochterman et al., 2005; Haugsdal & Scherb, 2003; C. A. Scherb, 2001). These results were expected because most patients admitted to ICU settings depend on artificial ventilation and vigilant respiratory care is critical for the ICU patient outcomes (Leslie, 2010). More general interventions such as *Pain Management, Fall Prevention, Teaching,* and *Skin Surveillance* were referred to as common NIC interventions in other studies with different patient groups: Home health care (Schneider & Slowik, 2009), Hospitalized patients with heart failure (Scherb, 2001).

Pain Management was one of four NIC interventions that were the most common nursing interventions used in 39 nursing specialty areas (McCloskey et al., 1998). In addition, if it is considered that 70% of ICU patients experienced at least moderate intensity procedure-related or post operative pain during ICU stays (Pasero et al., 2009).

This explains why *Pain Management* was the most frequently used NIC interventions in the ICU nursing care plans.

Pain Management, Ventilation Assistance, Acid-Base Management: Respiratory Acidosis, and *Airway Management* were all found among the ten most common interventions used in all three ICU types. While nursing interventions related to respiratory management were highly ranked in the MICU, nursing interventions related to physical comfort were highly ranked in the SICU. In the CVICU, the unique nursing interventions, which were *Cardiac Care, Acute* and *Teaching Preoperative*, relate to the typical characteristics of the patients admitted to a CVICU, which is a pre-operative cardiac unit. In addition, while the NIC interventions for cardiac patients in home health care were focused on monitoring patients' cardiac status in order to limit complications and maximize the functioning of their cardiovascular system (Schneider & Slowik, 2009), NIC interventions in this CVICU were more focused on current physical management needs of the patients.

NOC Outcomes

Seventy nine NOC outcomes were identified in the ICU nursing care plans of the hospital. Among them, NOC outcomes in the Physiological Domain were most frequently selected by ICU nurses. Bloodstream infection, ventilator- associated pneumonia, falls, pressure ulcers, pain, and education are commonly referred to as key nursing sensitive outcomes to evaluate the quality of nursing care in ICU settings (NQF, 2004; Whitman et al., 2002) The concepts of these nursing sensitive outcomes were similar to the concepts of the most frequently used NOC outcomes: *Pain Level, Infection Severity, Tissue Integrity, Knowledge, and Fall Prevention*. Moreover, these NOC

outcomes could be more valuable than other nursing sensitive outcomes because the NOC outcomes were more focused on the status of individual patients who received care while the outcomes used in previous studies were used as the incidence rates or prevalence rates of all patients or units.

Pain Level, Respiratory Status: Gas Exchange, Respiratory Status: Airway Patency, Knowledge: Fall Prevention and *Tissue Perfusion: Pulmonary* were all found among the ten most common NOC outcomes in each ICU. These NOC outcomes were also identified as the most commonly used NOC outcomes for hospitalized patient care in other studies (Behrenbeck, Timm, Griebenow, & Demmer, 2005; Park, 2010; Scherb, 2001). Nine NOC outcomes on the list were found in significantly different proportions in each ICU. In addition, *Activity Tolerance* for the SICU, *Blood Loss Severity, Respiratory Status: Ventilation*, and *Fluid Balance* for the MICU, and *Cardiac Pump Effectiveness, Endurance*, and *Tissue perfusion cardiac* for CVICU were unique outcomes in each ICU.

The difference between the admission and discharge outcome scores is the change of patient status over time after providing relevant nursing interventions (Moorhead et al., 2008). In this study, the average of NOC scores was 3.29 (SD=0.96) and 50 % of all NOC outcomes did not have changes in scores over ICU stays. Only the scores for 30.6% of NOC outcomes were increased at ICU discharge. The proportion of no change in NOC outcome score was much higher than in other studies. Recent studies found significant differences in several NOC outcome ratings from admission to discharge that explained the effectiveness of relevant nursing interventions on patient outcomes (Scherb et al., 2007). The reason that most of the NOC outcomes did not change in scores during

ICU stays might be that short ICU length of stay (average 2.7 days) was not enough for changes in the scores to occur. On average, half of NOC outcomes were rated only once or twice during the ICU stay. In addition, the discharge scores on the outcomes selected were not collected as part of this study.

NOC outcomes of nursing care plans should be regularly evaluated and revised as needed. In the policy for nursing care plans at this hospital, a nursing care plan should be initiated by the registered nurse within 24 hours of admission and be updated during the patient's stay. However, most of the NOC outcomes were not rated within 24 hours. On average the NOC outcome was rated once every 35.1 hours. Encouragement of nurses to document outcomes at prescribed intervals is important for identifying changes in patient status after interventions are provided.

Comparison of Core Interventions and Outcomes for Critical Care Nursing Suggested by Experts

The difference between the practical use of NIC interventions and NOC outcomes in ICU nursing care plans and core interventions and outcomes for critical care nursing suggested by experts (Bulechek et al, 2008; Moorhead et al, 2008) were examined. The number of common interventions and outcomes on the lists were lower than expected. In particular, most of the top ten items, which account for above 50% of all NIC interventions and NOC outcomes used in ICU nursing care plans, were missing from core interventions and outcomes suggested by experts. In fact only 29% of core interventions for critical care nursing and 37% of core outcomes for critical care outcomes were matched in this comparison. However, items that were labeled differently often

contained similar concepts. For example, even though *Acid-Base Management* was not in the core interventions, *Acid-Based Monitoring* including a similar concept was on the list.

NIC interventions and NOC outcomes related to patient safety such as fall prevention and skin surveillance were common in current nursing care plans but were not in core lists. After the Institute of Medicine (IOM)'s report raised a concern about patient safety, nursing care related to patient safety became the most important part of nursing care quality and cost. The rates of fall, pressure ulcers, and hospital acquired infections become considered as the indicators of nursing care quality. Moreover, the Centers for Medicare and Medicaid Services (CMS) does not reimburse hospitals for treating hospital – acquired pressure ulcers (Stage III or IV) (CMS, 2008).

NIC interventions used in actual ICU nursing care plans were missing several important core interventions for critical care nursing that one would expect ICU nurses are delivering to their patients. For examples, *Mechanical Ventilation Management*, *Respiratory Monitoring*, or *Oxygen Therapy* did not appear in ICU nursing care plans. Even though nursing interventions related to drug management account for an important part of nursing interventions delivered to ICU patients, those NIC interventions were not identified. We can assume that these specific interventions occurred and expressed in more general interventions related to respiratory care such as *Ventilation Care* or *Airway Management.*

On the other hand, there was a lack of nursing interventions related to the neurologic management for neurologically impaired patients in current core interventions for critical care nursing. Even though *Intracranial Pressure Monitoring* was evident, *Cerebral Edema Management, Cerebral Perfusion Promotion*, and *Seizure Management*,

which were identified in nursing care plans of the hospital, could be included in core interventions for Critical Care Nursing.

The NOC outcomes that were not listed as core outcomes for critical care nursing could be used for nursing care for more general patient groups not just for critical care nursing. In particular, NOC outcomes in the domain of Health Knowledge & Behavior were prevalent in the list of NOC outcomes not matched. On the other hands, *Infection Severity* could be included in core outcomes for critical care nursing if it is considered that blood stream infection is an important nursing sensitive outcome.

Factors Related to the Changes in Nursing Sensitive Outcomes

The patient factors profoundly influence the effect of the treatment on patient outcomes. These patient factors are defined as risk factors and these risk factors should be acknowledged when making presumptions about the effectiveness of care on patient outcomes (Iezzoni, 2003). Without adjusting for these factors, the evaluations for the effectiveness of care are biased. Therefore, identifying the factors such as age that limit the change in the NOC outcome scores is useful to reveal the unique effect of nursing interventions on the nursing sensitive outcomes.

This study found an association between the ICU length of stay and the change of four NOC outcome scores: *Pain Level, Respiratory Status: Gas Exchange, Respiratory: Airway Patency,* and *Tissue Integrity: Skin and Mucous Membranes.* There were significant associations between longer ICU length of stay and decreased NOC outcome scores. This finding is consistent with results of other studies that showed an increased risk of severe complications (Soares et al., 2008) or a higher mortality rate (Laupland, Kirkpatrick, Kortbeek, & Zuege, 2006) in patients with a prolonged ICU length of stay.

Increased age has often been considered as an independent risk factor on poor patient outcomes in ICU settings. Many studies showed that older age was negatively associated with ICU length of stay or hospital mortality (de Rooij et al., 2005; Vosylius et al., 2005). However, our findings didn't support the results of previous studies. In this study, even though age was associated with the change in the *Respiratory Status: Gas Exchange* score, the increased age influenced the decrease as well as the increase in the NOC outcome score.

The results of this study show a significant impact of gender on the change of *Pain Level* score. Females were more likely to have a decrease in *Pain Level* score. There is a lot of controversy over the effect of gender on pain level. Some studies suggested menstrual cycle, hormones or psychogenic factors contributed to gender differences on perceived pain (Greenspan et al., 2007).

The number of NANDA - I diagnoses was significantly associated with change in *Infection Severity* and *Respiratory Status: Airway* scores even though comorbid disease scores or specific medical diagnoses didn't show significant association between the change in the NOC scores. Particularly, as the number of NANDA - I diagnoses increased, so did the likelihood of a decrease in *Infection Severity* score. This finding supports previous studies that nursing diagnoses could be a predictor for poor patient outcomes. A few studies showed that the nursing diagnoses were associated with poor patient outcomes resulting in higher total hospital charges, longer ICU length of stay, and higher in-hospital mortality (Halloran et al., 1988; Rosenthal et al., 1995; Welton & Halloran, 2005). In particular, Rosenthal and colleagues (1992, 1995) have used the number of 34 specific nursing diagnoses as a Nursing Severity Index. This score was

significantly related to in-hospital death rates, hospital charges, and length of stay. In other words, patients having more nursing diagnoses tend to be in a worse condition overall.

Prior studies have showed that richer nursing staff ratios or a higher proportion of RN caregivers resulted in improved patient outcomes such as lower mortality rate, pressure ulcer rate and infection rate (Amaravadi et al., 2000; Dang et al., 2002; Hickey et al., 2010; Hugonnet et al., 2007). Particularly, the effect of nursing staff ratios on patient outcomes was highlighted even more in ICU settings because critical care nurses should detect the change in patient status early and provide nursing interventions promptly to critically ill patients (Dang et al., 2002). However, this study didn't show any significant effect of nursing staff to patient ratio or skill mix of nursing caregivers on the change in five NOC outcome scores. In previous studies, above a 1:2 nursing staff to patient ratio was a predictor of poor patient outcomes. However, the overall nursing staffing of this hospital was richer than the ratio of nursing staff to patients in other studies. In this study, the nursing staff to patient ratio of the ICUs was below 1:2 and the proportion of RN hours in skill mix of nursing care givers was almost above 0.9. Therefore, the result didn't show the significant effect of nursing staff on the NOC outcomes. In addition, this hospital does not have much variation in nursing staffing according to type of ICU. This likely explains why there was no association between the ICU type and the change in the NOC outcome scores.

Limitations of the Study

There are several limitations to this study. First of all, the quality and accuracy of nursing care plans could be a limitation. The knowledge for the use of NNNs is critical to support nurses' ability to select accurate nursing diagnoses, appropriate nursing interventions, and nursing outcomes in the EHR. We did not measure the nurses' knowledge of and competency in the use of NANDA - I diagnoses, NOC outcomes, and NIC interventions which can vary depending on their education. In addition, the nursing care plans of this hospital were using the classification label level for measurement of NOC outcomes. These labels of NOC outcomes are dependent on multiple indicators to rate accurately. The indicators are provided as they were in the design of the system and nurses are given the level of information on the display screen to support their scoring.

The ability to accurately rate NOC outcomes influences the psychometrics of NOC outcome measure. The reliability of NOC outcome measures is crucial to interpret and score labels and indicators in a reasonably consistent manner because ICU patients often move from general units to ICUs or from ICUs to other units. Several studies have tested the validity, reliability, and sensitivity of the NOC outcomes in several clinical settings: Adult care nurse practitioner (Keenan et al., 2003); community level (Head et al., 2004), tertiary care settings (Behrenbeck et al., 2005), and nursing homes (Schneider, Barkauskas, & Keenan, 2008). Few studies have tested the psychometrics of several NOC outcomes used in ICU settings (Moorhead et al., 2004). Therefore, there is still a lack of studies testing the reliability of common NOC outcomes used in specific to ICU settings.

In addition, the data outside the ICU were not examined and the discharge NOC outcome scores of patients were not known in this study. As a result, the study could not explore significant changes in NOC outcome scores over time.

Another limitation is related to the lack of available care plan sets in the hospital information system. The hospital information system has pre- templates of nursing care plans developed by the staff of the department in nursing informatics. Based on *NANDA, NOC, and NIC Linkage (2nd edition*), approximately 100 NNN linkages were entered into Epic as care plan sets. These pre-templates of nursing care plans have little variety and thus, some pre-templates of care plans have already grouped been under specific titles such as “Cardiac Patients” or “Intubated Patient” consisting of 12-13 NNN linkages. In addition, the linkages suggest very limited options for nursing interventions. Most NNN linkages in the current Epic system consist of 1 NANDA - I diagnosis, 1 or 2 NOC outcomes, and 1 to 3 NIC interventions. For example, *Acute Pain,* which is the most common NANDA - I diagnosis, is linked to only two NOC outcomes (*Pain Level* and *Pain Control)*. The *Pain Level* has the only option for NIC intervention (*Pain Management)* and *Pain control* had two NIC interventions (*Pain Management* and *Analgesic Administration*) in Epic. Comparing with the NNN linkage book (Johnson et al., 2006), NIC interventions related to medication are still missing in the system (e.g. *Medication Management*). Therefore, nurses could have some difficulty in developing appropriate nursing care plans due to the relatively small pools of care plans and limited options of NIC interventions. The results of this study also showed that several important NANDA - I diagnoses, NOC outcomes, and NIC interventions are absent from the

current care plan database of this hospital. These missing items should be included in the hospital information system to establish accurate nursing care plans for ICU patient care.

Clinical nurses often consider nursing care plans as no value to direct patient care. These nursing care plans are not part of care delivery workflow (Langford, Tinker, & Martial, 2010). Nurses often perceive recording nursing care plans as additional work. Furthermore, the nursing care plans of this hospital also work independently in the health information system. For nursing interventions, nursing care plans didn't give any information when and how often nurses provided the nursing interventions to patients. Even though nurses documented their activities in nursing flow sheets, the information is scattered all around the hospital information system. Because of this issue, the dose of nursing interventions was not identified and this study could not determine the effect of NIC interventions on NOC outcomes.

The multinomial logistic regression model conducted to determine the effects of the variables on the NOC outcomes has a limitation. A multinomial logistic regression needs a significantly large sample sizes across all levels and of the dependent variable and independent variables to estimate accurately parameters. Among three categories of the dependent variable, the change of the NOC outcome score, the proportion of 'No change' group were higher than the other two groups. The proportion is almost two times that of the other categories. This distribution could influence the accurate estimation of parameters and the interpretation of study results. In addition, the relatively small sample size for each NOC outcome could be also a limitation to estimate the parameter accurately. Clinical data collected from only one hospital in Midwest area may limit the generalizablity of the result of this study.

Lessons Learned from Data Extraction Process

Contrary to the original data collection plan, NANDA - I diagnoses, NOC outcomes, and NIC interventions used in nursing care plans were manually retrieved from the electronic health records (EHRs).

The merit of EHRs is the ability to collect and store the data once and then we use them many times for the various purposes. Moreover, the use of NANDA - I, NOC, and NIC in EHRs increase the ability to extract data for analyzing relationships among nursing diagnoses, interventions, and outcomes and for determining the effectiveness of nursing practice. However, even though we have a plenty of data sources from the hospital information system, if we don't have the knowledge for data management, the information will not be available. In this context, the issue of data extraction process appeared due to the lack of human resources in nursing informatics department responsible for creating queries and reporting of nursing care information. Therefore, practicing nurse informaticists are needed for their knowledge and skills in creating and maintaining databases, developing and revising interfaces, and developing data-entry forms. This competency in data structures and management is currently recognized in ANA nursing informatics certification (Courtney, Goodwin, & Aubrecht, 2011).

Implications for Nursing

Practice

The results of this study ultimately encourage developing standardized care plan sets that include ICU specific content in EHR. The nursing care plan sets will also help nurses' decision making for ICU patient care. According to each ICU type, specific care

plan sets including NNNs will help nurses to develop evidence - based nursing care plans for each ICU patient by providing possible options.

Identifying nursing diagnoses, nursing interventions, and nursing outcomes for ICU patient care had been helpful for educating nursing staff and evaluating nurse competency (Bulechek et al., 2008). Nurses working in the ICU settings should be competent in the nursing interventions commonly used in the ICUs such as *Pain Management* or *Respiratory Management*. Therefore, the identified nursing diagnoses, nursing interventions, and nursing outcomes will be a basis for education programs to maintain the ICU nursing staff's competency.

Education

The lack of knowledge for the use of NNN can be an issue for the accurate use of NNN as described in the study limitations, Education on understanding the meaning of concepts and using the three languages reliably is necessary for nurses. Therefore, the education program for the use of NNN, clinical reasoning, and critical thinking should be provided to new nurses during training periods or to undergraduates. The accuracy of nursing diagnoses is more important because nursing diagnoses lead to appropriate nursing outcomes and nursing interventions in the use of pre-templates of nursing care plans in the EHR. Therefore, critical thinking abilities for diagnostic accuracy should be developed (Lunney, 2003). On the other hand, a few strategies to help accurate use of NNN can be suggested to nurses and nursing students. Pesut and Herman (1998) work using a clinical reasoning web, helps in clinical decision making and prioritizing diagnoses, is one of useful strategies (Pesut & Herman, 1998).

Research

This study describes the potential for clinical data extracted from electronic documentation with NNN in nursing research. These clinical data could be used for various purposes such as nursing effectiveness studies.

Further research could be conducted to identify the association between NIC interventions and NOC outcomes with additional data for NIC interventions. The identified risk factors from the current study could be useful to determine the unique effect of NIC interventions on the NOC outcomes controlling for these risk factors. More research with larger sample size requires to generalize the results of this study and to establish stronger multinomial logistic regression models. A year study might be valuable to capture seasonal variations in the use of NNNs. Advancing research to follow patients during entire hospital stay could be conducted to compare similarities and differences in the use of NNNs between non- ICU units and ICUs.

However, first of all, the problem of data extraction from the electronic data repository should be solved. The nursing care plans of this hospital works independently in the clinical information system. Detailed nursing care provided to patients is documented in nursing flow sheets. Therefore, the study to create the relational data modeling among the flow sheets and nursing care plans should be conducted. Based on the concepts of interventions on nursing flow sheets and nursing care plans, entity-relationship modeling and logical design should be developed as a basic step to link. This design and construction of a relational database from the hospital data repository make it easier manage, manipulate, and analyze nursing care data.

Conclusion

The purpose of this study was to identify NANDA - I diagnoses, NOC outcomes, and NIC interventions used in nursing care plans for ICU patient care. Eighty one NANDA - I diagnoses, 79 NOC outcomes, and 90 NIC interventions were identified in the nursing care plans in the health information system. *Acute Pain - Pain Level - Pain Management* was the most frequently used NNN linkage followed by *Impaired Gas Exchange-Respiratory Status: Airway Patency-Acidosis*. The examined differences in each ICU provide knowledge about care plan sets that may be useful. When the NIC interventions and NOC outcomes used in the actual ICU nursing care plans were compared with core interventions and outcomes for critical care nursing suggested by experts, the core lists could be expanded. Lastly, the five most commonly used NOC outcomes, *Pain Level, Respiratory Status: Gas Exchange, Respiratory: Airway Patency, Infection Severity,* and *Tissue Integrity: Skin and Mucous Membranes,* were used for further analysis with study variables. Several factors contributing to the change in these NOC outcome scores were identified.

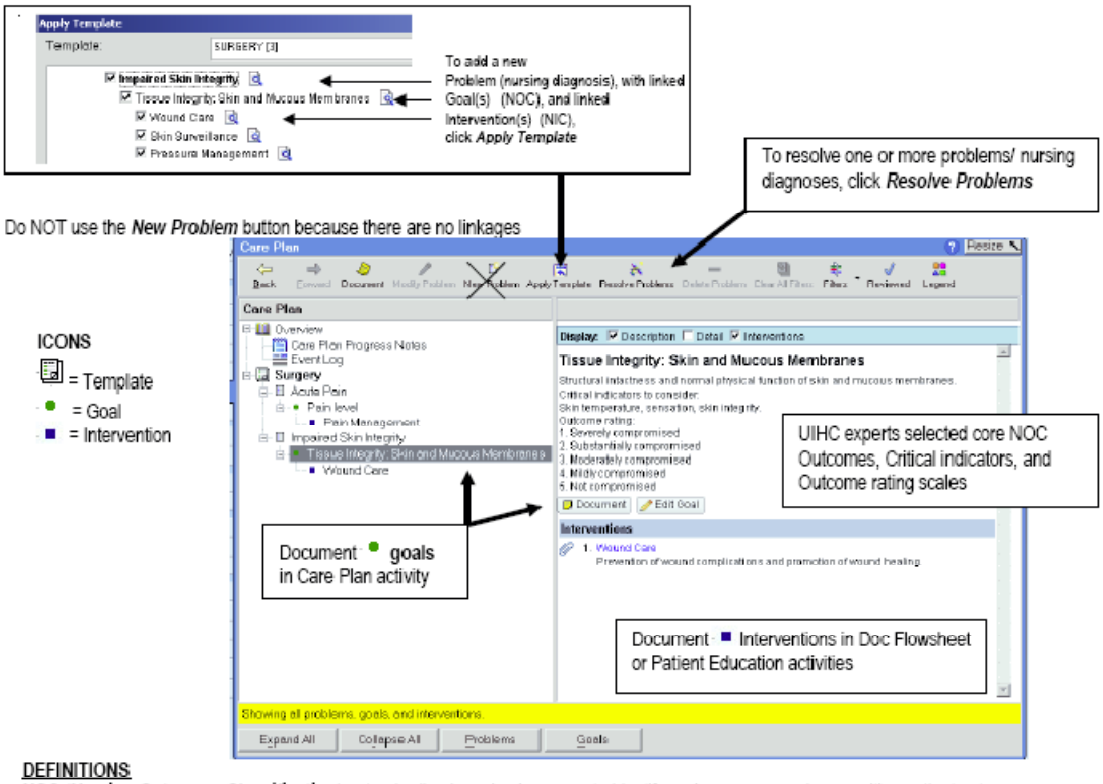
There have been several studies to identify nursing diagnoses, nursing outcomes, and nursing interventions for patient groups with certain medical diagnoses. This study is more meaningful because the study includes all ICU patients to identify nursing practice in a specialty area with actual data as well as the first extraction of nursing care data from Epic of the hospital.

Nurses working in the ICU settings should be competent in the specialized skills and knowledge to coordinate care for vulnerable patients. In this respect, the results of this study will prove valuable for the development of knowledge for ICU patient care.

This study also demonstrated the usefulness of NANDA - I, NOC, and NIC used in nursing care plans of the EHR. The study shows that the use of these three terminologies encourages interoperability, and reuse of the data for quality improvement or effectiveness studies.

APPENDIX A

EPIC CARE PLANNING USING NOC



DEFINITIONS:

NOC (Nursing Outcomes Classification) - standardized nursing language to identify and measure nursing-sensitive patient outcomes

Outcome – pt/family state, behavior or perception that is measured along a continuum in response to nursing intervention(s). Each outcome has a definition, an associated group of critical indicators, and an outcome rating scale.

Critical indicator - a more concrete pt/family state, behavior or perception that serves as a cue to determine patient status in relation to rating the outcome

Outcome rating –a five-point measurement scale that quantifies a patient outcome status on a continuum from 1(least) to 5 (most desirable). Different measurement scales are used for different outcomes, but they all measure 1 as worst and 5 as best. When you make a judgment to select an outcome rating, **compare your patient to a healthy individual of approximately the same age and gender.**

COMPARISON of INFORMM OUTCOME and NOC GOAL* in EPIC

	INFORMM OUTCOME	NOC GOAL* IN EPIC
Example	*Pt's skin and tissue integrity is enhanced*	*Tissue Integrity: Skin and Mucous Membranes*
Description	A desired condition or goal to work toward - what the pt's status needs to be in order to resolve the problem	A variable concept described in neutral terms [The nurse and pt decide what the pt's desired condition or expected outcome by selecting an "Outcome Target Rating," a desired point on the measurement scale. This feature is not yet available in Epic.]
Measure	Measure against a desired condition	Measure along a continuum of 1 to 5
Measurement scale	3-point scale • MET • NOT MET, MAKING PROGRESS • NOT MET, NO PROGRESS	5-point scale measures the pt's condition in relation to the outcome more concisely. The change in rating score captures slight changes in the pt's condition rather than just met or not met.
Subjectivity	Must use nursing judgment	Must use nursing judgment. Review critical indicators to help determine the rating.
Outcome rating frequency	Audit at least every 6 days	Follow divisional or unit standards for how often to rate an outcome.

*Even though Epic uses the word "goal," NOC outcomes are not goals by definition.

APPENDIX B

POLICY AND PROCEDURE MANUAL: CARE PLANS, PATIENTS

UNIVERSITY of IOWA HOSPITALS & CLINICS
University of Iowa Health Care

Policy and Procedure Manual

Department of Nursing Services and Patient Care Standards of Practice — N-09.060

SUBJECT/TITLE: Care Plans, Patient

PURPOSE: To establish a guide for nursing staff to use in providing consistent care to meet patient needs.

DEFINITION: None.

RESPONSIBILITY: The Registered Nurse will be responsible for contributing to the interdisciplinary care plan.

DEFINITIONS:

Order: An assessment or treatment prescribed for the patient by registered nurse, physician, or other authorized provider and performed by direct care givers.

Order Group: Related patient care orders. A nursing intervention is a type of order group. The Iowa Intervention Project defines Nursing Interventions Classification (NIC) interventions as "any treatment, based upon clinical judgment and knowledge, that a nurse performs to enhance patient/client outcomes." NIC interventions are a standardized nursing language.[L1]

Problem/Nursing Diagnosis: A clinical judgment about individual, family, or community responses to actual or potential health problems/life processes. A nursing diagnosis provides the basis for selection of nursing interventions to achieve outcomes for which the nurse is accountable. NANDA nursing diagnoses are a standardized nursing language.[L2]

Outcome (Goal): A description of a patient's status at a particular point in time that is measured along a continuum in response to nursing intervention(s).

Outcome Indicator: Observable patient state, behavior or self-reported perception or evaluation that is sensitive to nursing intervention. Patient progress related to an outcome indicator is rated using a five-point Likert scale, used in the EMR. NOC outcome indicators and outcome measures are a standardized nursing language.[L3] Salient acute care indicators are listed with the goal.

POLICY:

A. A documented care plan will be initiated by the Registered Nurse on every patient with a visit type of inpatient (INPT), Psych Inpatient (INPSY) or outpatient surgery and recovery (OSRGRE) for a hospital stay longer than 24-hours. The care plan will be initiated within 24 hours of admission and will be updated during the patient's stay. The need for a documented plan of care for patients with a visit type of observation (OBSERV), or outpatient visit in a bed (OPBED) will be determined by the individual nursing divisions.

1. The Registered Nurse will contribute to and update the care plan based on nursing process (ongoing assessment and data collection, diagnosis, planning, treatment, evaluation).

2. Established standards of nursing practice will be used in developing and updating the care plan.

3. Nursing interventions for physiological and psychological care as well as preventive nursing activities will be included.

4. The patient/family are to be informed about and involved in the patient's care as appropriate.

5. The care plan will reflect collaboration with other health care professionals and will support other disciplines in carrying out those functions appropriate to them.

6. Revision and implementation of changes in the care plan will be done in a timely manner throughout the patient's stay and upon discharge, based on evaluation and ongoing assessment of the patient's condition.

B. The Licensed Practical Nurse will contribute to the care plan under supervision of the Registered Nurse.

PROCEDURE FOR COMPUTERIZED CARE PLAN, EPIC:

1. Add care plan problems, goals and interventions related to the LIP orders and nursing assessment of patient condition.

2. Review/update the care plan as needed to add, update, or delete problems, goals, and interventions based on changes in patient condition.

3. Rate the outcome for each problem/nursing diagnosis goal to document the patient's progress. Determine whether to retain or resolve the problem/nursing diagnosis.

Note: Entry of patient demographics, patient/family education, LIP orders, and discharge planning are activities separate from the formal care plan in the EMR.

Related Department of Nursing Standards:
Policy N-0.070 Discharge Planning
Policy N-0.071 Education, Patient
Policy N-09.050 Procedure for Noting, Documenting Fulfillment and Validating Patient Care Orders from Doctors' Orders (A1a)

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L1 Dochterman, J., & Bulechek, G. (Eds.), 2004. Iowa Intervention Project Nursing Interventions Classification (NIC), 3rd edition. St. Louis: Mosby.

L2 NANDA International. (2007). Nursing Diagnoses: Definitions & Classification 2007-2008. Philadelphia, PA: Author.

L3 Moorhead, S., Johnson, M. Maas, J. (Eds.) (2004). Nursing Outcomes Classification (NOC), 3rd edition. St. Louis, MO: Mosby.

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APPENDIX C
LIST OF COMORBID MEDICAL CONDITIONS

Comorbidity	ICD-9-CM Codes	DRG Screen: Case Does *Not* Have the Following Disorders (DRG):
1. Congestive heart failure	398.91, 402.11, 402.91, 404.11, 404.13, 404.91, 404.93, 428.0–428.9	Cardiac[a]
2. Cardiac arrhythmias	426.10, 426.11, 426.13, 426.2–426.53, 426.6–426.89, 427.0, 427.2, 427.31, 427.60, 427.9, 785.0, V45.0, V53.3	Cardiac[a]
3. Valvular disease	093.20–093.24, 394.0–397.1, 424.0–424.91, 746.3–746.6, V42.2, V43.3	Cardiac[a]
4. Pulmonary circulation disorders	416.0–416.9, 417.9	Cardiac[a] or COPD (88)
5. Peripheral vascular disorders	440.0–440.9, 441.2, 441.4, 441.7, 441.9, 443.1–443.9, 447.1, 557.1, 557.9, V43.4	Peripheral vascular (130–131)
6. Hypertension (*combined*)		
Hypertension, uncomplicated	401.1, 401.9	Hypertension (134)
Hypertension, complicated	402.10, 402.90, 404.10, 404.90, 405.11, 405.19, 405.91, 405.99	Hypertension (134) or cardiac[a] or renal[a]
7. Paralysis	342.0–342.12, 342.9–344.9	Cerebrovascular (5, 14–17)
8. Other neurological disorders	331.9, 332.0, 333.4, 333.5, 334.0–335.9, 340, 341.1–341.9, 345.00–345.11, 345.40–345.51, 345.80–345.91, 348.1, 348.3, 780.3, 784.3	Nervous system (1–35)
9. Chronic pulmonary disease	490–492.8, 493.00–493.91, 494, 495.0–505, 506.4	COPD (88) or asthma (96–98)
10. Diabetes, uncomplicated[b]	250.00–250.33	Diabetes (294–295)
11. Diabetes, complicated[b]	250.40–250.73, 250.90–250.93	Diabetes (294–295)
12. Hypothyroidism	243–244.2, 244.8, 244.9	Thyroid (290) or endocrine (300–301)
13. Renal failure	403.11, 403.91, 404.12, 404.92, 585, 586, V42.0, V45.1, V56.0, V56.8	Kidney transplant (302) or renal failure/dialysis (316–317)
14. Liver disease	070.32, 070.33, 070.54, 456.0, 456.1, 456.20, 456.21 571.0, 571.2, 571.3, 571.40–571.49, 571.5, 571.6, 571.8, 571.9, 572.3, 572.8, V42.7	Liver[a]
15. Peptic ulcer disease excluding bleeding	531.70, 531.90, 532.70, 532.90, 533.70, 533.90, 534.70, 534.90, V12.71	GI hemorrhage or ulcer (174–178)
16. AIDS[b]	042–044.9	HIV (488–490)

Source : Comorbidity Measures for Use with Administrative Data. *Medical Care*, 36(1), 8-27.

APPENDIX D

AVERAGE AND CHANGE OF NOC OUTCOME SCORES OVER ICU STAY

	The change of NOC outcome score				Average of score	
NOC outcomes	n	Decline	No change	Improve	M	SD
Pain level	276	44	152	80	3.6	0.9
Respiratory Status: Gas Exchange	172	20	78	74	3.4	0.8
Respiratory Status: Airway Patency	157	20	63	74	3.2	0.8
Infection Severity	147	27	80	40	3.5	0.9
Tissue Integrity: Skin and Mucous Membranes	130	26	78	26	3.6	1.0
Knowledge: Treatment Procedure	129	11	75	43	3.0	0.8
Tissue perfusion: pulmonary	117	17	48	52	3.4	0.9
Knowledge: Fall Prevention	101	12	66	23	3.1	1.1
Fall Prevention: Behavior	77	8	51	18	3.4	1.1
Activity Tolerance	70	6	47	17	2.8	0.9
Pain Control	56	8	32	16	3.8	0.7
Knowledge: Illness Care	53	5	32	16	2.6	0.9
Respiratory Status: Ventilation	53	3	24	26	3.3	0.8
Blood Loss Severity	50	7	23	20	3.6	0.8
Mobility	42	5	31	6	2.8	0.9
Anxiety Level	36	8	22	6	3.5	0.8
Aspiration Prevention	35	6	23	6	3.1	1.2
Fluid Balance	32	4	20	8	3.2	1.0
Nausea and Vomiting Severity	31	0	23	8	3.8	1.0
Nutritional Status	31	4	17	10	2.6	0.8
Cardiac Pump Effectiveness	30	2	17	11	3.3	0.9
Acute Confusion Level	29	4	17	8	3.1	1.2
Coping	29	4	22	3	2.5	0.9
Neurological status	28	4	19	5	2.9	1.1
Hydration	27	3	17	7	3.2	0.7
Sleep	27	3	18	6	3.0	0.8
Tissue Perfusion: Cerebral	27	2	15	10	3.1	1.0
Endurance	26	3	17	6	3.2	0.9
Tissue perfusion: cardiac	23	4	14	5	3.4	0.8
Fluid Overload Severity	20	2	9	9	3.3	0.9
Gastrointestinal Function	18	0	10	8	3.1	1.1
Depression Level	17	1	11	5	2.6	0.9
Bowel Elimination	16	5	7	4	3.1	1.0
Neurologic Status: Peripheral	15	4	10	1	3.5	1.1
Suicide Self-Restraint	15	2	10	3	2.8	1.2
Risk Control: Hyperthermia	14	1	6	7	3.4	1.1
Seizure control	12	1	7	4	3.8	1.3
Risk Control: Hypothermia	11	0	7	4	3.8	1.0
Body Positioning: Self-Initiated	10	0	4	6	3.1	0.9

Cognitive Orientation	10	0	7	3	3.8	1.0
Communication	10	0	7	3	2.8	1.2
Swallowing Status	10	3	6	1	2.8	1.1
Tissue Perfusion: Peripheral	10	1	6	3	3.4	0.8
Kidney Function	9	2	3	4	2.7	1.0
Substance Withdrawal Severity	9	1	6	2	3.4	1.1
Cognition	7	0	6	1	4.1	0.9
Health Seeking Behavior	6	0	4	2	2.5	1.0
Knowledge: Personal Safety	6	0	4	2	3.3	1.2
Self-Care: Activities of Daily Living(ADL)	6	1	3	2	2.8	1.3
Urinary Elimination	6	0	5	1	3.5	1.0
Blood Glucose Level	5	0	2	3	3.0	1.0
Compliance Behavior	5	0	4	1	2.6	0.5
Diabetes Self-Management	4	1	2	1	2.3	0.5
Grief Resolution	4	1	3	0	3.5	1.0
Hope	4	1	3	0	1.3	0.5
Spiritual Health	4	1	3	0	4.3	1.5
Tissue Integrity: Skin and Mucous Membrane	4	1	1	2	3.8	0.5
Family Coping	3	0	3	0	4.3	0.6
Heedfulness of Affected Side	3	0	1	2	3.7	0.6
Oral Hygiene	3	0	3	0	4.3	0.6
Treatment Procedure	3	0	2	1	2.7	1.2
Infection Protection	2	1	1	0	3.5	0.7
Knowledge: Treatment Regimen	2	0	2	0	3.5	2.1
Pain: Disruptive Effects	2	1	1	0	3.0	1.4
Self-Mutilation Restraint	2	0	2	0	4.0	1.4
Social Involvement	2	0	1	1	3.0	1.4
Thermoregulation: Peds	2	0	1	1	2.0	0.0
Allergic Response: Systemic	1	0	1	0	5.0	.
Balance	1	0	1	0	3.0	.
Breastfeeding Establishment: Maternal	1	0	1	0	2.0	.
Cognitive Restructuring	1	0	1	0	4.0	.
Dignified Life Closure	1	0	1	0	4.0	.
Family Integrity	1	0	1	0	3.0	.
FREE FROM ACCIDENTAL PHYSICAL INJURY	1	0	1	0	5.0	.
Ineffective Coping	1	0	1	0	2.0	.
Memory	1	0	1	0	3.0	.
Mutual Goal Setting	1	0	0	1	3.0	.
Oral Intake	1	0	1	0	1.0	.
Risk Control	1	1	0	0	3.0	.
Sensory Function: Vision	1	0	1	0	3.0	.
Total	2345	302	1325	718	3.3	1.0

APPENDIX E

NANDA- I DIAGNOSES, NOC OUTCOMES, AND NIC INTERVENTIONS IN THREE ICU TYPES

NANDA - I Diagnoses in three ICUs	ICU Type			Total
	SICU	MICU	CVICU	
Acute Pain	210	30	27	267
Risk for Infection	99	42	8	149
Ineffective Airway Clearance	80	57	20	157
Impaired Gas Exchange	78	64	18	160
Impaired Skin Integrity	71	3	3	77
Risk for Falls	63	27	12	102
Deficient Knowledge Pre/Post Procedure/Surgery	60	2	23	85
Ineffective Tissue Perfusion: Pulmonary	60	37	20	117
Activity Intolerance	41	19	11	71
Impaired Physical Mobility	36	6	0	42
Risk for Impaired Skin Integrity	31	4	17	52
Deficient Knowledge, Disease Process	28	22	8	58
Ineffective Tissue Perfusion, Cerebral	28	3	0	31
Decreased Intracranial Adaptive Capacity	27	1	0	28
Sleep Deprivation	26	1	0	27
Anxiety	25	5	6	36
Ineffective Breathing Pattern	23	27	3	53
Nausea	23	7	1	31
Acute Confusion	22	7	0	29
Risk for Constipation	14	3	1	18
Risk for Peripheral Neurovascular Dysfunction	14	1	0	15
Risk for Bleeding	12	36	2	50
Risk for Imbalanced Fluid Volume	12	12	3	27
Risk for Aspiration	11	10	1	22
Imbalanced Nutrition: Less than Body Requirements	10	17	3	30
Impaired Swallowing	10	2	1	13
Risk for Imbalanced Body Temperature	9	7	1	17
Impaired Bed Mobility	7	2	0	9
Impaired Verbal Communication	7	1	2	10
Decreased Cardiac Output	6	7	17	30
Impaired Tissue Integrity	6	0	0	6
Ineffective Tissue Perfusion: Cerebral	6	0	0	6
Disturbed Thought Processes	5	4	4	13
Risk for Activity Intolerance	5	1	10	16
Urinary Retention	5	0	0	5
Impaired Spontaneous Ventilation	4	5	1	10
Ineffective Tissue Perfusion, Peripheral	4	0	1	5
Constipation	3	2	0	5
Ineffective Tissue Perfusion: Cardiac	3	6	14	23
Risk for Withdrawal: Alcohol/Drugs	3	5	1	9
Deficient Knowledge	2	0	0	2
Excess Fluid Volume	2	8	10	20

Ineffective Tissue Perfusion, Renal	2	5	2	9
Risk for Deficient Fluid Volume	2	13	1	16
Risk for Injury	2	5	0	7
Self-Care Deficit	2	2	0	4
Bathing/Hygiene Self-Care Deficit	1	1	0	2
Chronic Pain	1	8	0	9
Deficient Fluid Volume	1	13	2	16
Deficient Knowledge, Insulin Therapy	1	3	0	4
Disturbed Body Image	1	0	0	1
Disturbed Sensory Perception, Kinesthetic	1	0	0	1
Disturbed Sensory Perception, Visual	1	0	0	1
Effective Breastfeeding	1	0	0	1
Grieving	1	3	0	4
Impaired Memory	1	0	0	1
Impaired Urinary Elimination	1	0	0	1
Ineffective Coping	1	18	3	22
Ineffective Tissue Perfusion	1	3	1	5
Noncompliance	1	3	1	5
Risk for Latex Allergy Response	1	0	0	1
Risk for Unstable Blood Glucose	1	4	0	5
Social Isolation	1	1	0	2
Unilateral Neglect	1	2	0	3
Airway clearance, ineffective	0	1	0	1
Diarrhea	0	11	0	11
Dysfunctional Ventilation Weaning Response	0	1	1	2
Fatigue	0	4	6	10
Hopelessness	0	4	1	5
Imbalanced Nutrition: More than Body Requirements	0	1	0	1
Impaired Oral Mucous Membrane	0	3	0	3
Inadequate Oral Food Beverage Intake	0	0	1	1
Ineffective Health Maintenance	0	5	1	6
Ineffective Thermoregulation	0	2	0	2
Interrupted Family Process	0	0	1	1
Mood Alteration: Depression	0	14	1	15
Readiness for Enhanced Family Coping	0	3	0	3
Readiness for Enhanced Spiritual Well-Being	0	1	0	1
Risk for Self-Directed Violence	0	2	0	2
Risk for Suicide	0	13	2	15
Spiritual Distress	0	3	0	3
	1217	645	273	2135

NOC Outcomes in three ICUs	ICU type			Total
	SICU	MICU	CVICU	
Pain Level	211	38	27	276
Tissue Integrity: Skin and Mucous Membranes	103	7	20	130
Infection Severity	97	42	8	147
Respiratory Status: Gas Exchange	82	70	20	172
Knowledge: Treatment Procedure	80	22	27	129
Respiratory Status: Airway Patency	80	57	20	157
Knowledge: Fall Prevention	63	26	12	101
Tissue perfusion: pulmonary	60	37	20	117
Fall Prevention: Behavior	47	24	6	77
Activity Tolerance	39	19	12	70
Mobility	36	6	0	42
Pain Control	36	15	5	56
Knowledge: Illness Care	29	18	6	53
Neurological status	27	1	0	28
Sleep	26	1	0	27
Anxiety Level	25	5	6	36
Tissue Perfusion: Cerebral	24	3	0	27
Nausea and Vomiting Severity	23	7	1	31
Respiratory Status: Ventilation	23	27	3	53
Acute Confusion Level	22	7	0	29
Aspiration Prevention	20	13	2	35
Gastrointestinal Function	14	3	1	18
Neurologic Status: Peripheral	14	1	0	15
Blood Loss Severity	12	36	2	50
Hydration	12	12	3	27
Seizure Control	12	0	0	12
Nutritional Status	10	18	3	31
Body Positioning: Self-Initiated	8	2	0	10
Swallowing Status	8	2	0	10
Communication	7	1	2	10
Risk Control: Hyperthermia	7	6	1	14
Cardiac Pump Effectiveness	6	7	17	30
Risk Control: Hypothermia	6	4	1	11
Tissue Perfusion: Peripheral	6	3	1	10
Urinary Elimination	6	0	0	6
Cognition	5	1	1	7
Coping	5	20	4	29
Endurance	5	5	16	26
Tissue Integrity: Skin and Mucous Membrane	4	0	0	4
Bowel Elimination	3	13	0	16
Fluid Balance	3	26	3	32
Self-Care: Activities of Daily Living(ADL)	3	3	0	6
Substance Withdrawal Severity	3	5	1	9
Tissue Perfusion: Cardiac	3	6	14	23
Cognitive Orientation	2	4	4	10
Fluid Overload Severity	2	8	10	20
Infection Protection	2	0	0	2
Kidney Function	2	5	2	9

Allergic Response: Systemic	1	0	0	1
Balance	1	0	0	1
Blood Glucose Level	1	4	0	5
Breastfeeding Establishment: Maternal	1	0	0	1
Cognitive Restructuring	1	0	0	1
Compliance Behavior	1	2	2	5
Diabetes Self-Management	1	3	0	4
Grief Resolution	1	3	0	4
Heedfulness of Affected Side	1	2	0	3
Knowledge: Personal Safety	1	5	0	6
Knowledge: Treatment Regimen	1	0	1	2
Memory	1	0	0	1
Pain: Disruptive Effects	1	1	0	2
Risk Control	1	0	0	1
Sensory Function: Vision	1	0	0	1
Social Involvement	1	1	0	2
Treatment Procedure	1	1	1	3
Depression Level	0	16	1	17
Dignified Life Closure	0	1	0	1
Family Coping	0	3	0	3
Family Integrity	0	0	1	1
FREE FROM ACCIDENTAL PHYSICAL INJURY	0	1	0	1
Health Seeking Behavior	0	5	1	6
Hope	0	3	1	4
Ineffective Coping	0	1	0	1
Mutual Goal Setting	0	1	0	1
Oral Hygiene	0	3	0	3
Oral Intake	0	0	1	1
Self-Mutilation Restraint	0	2	0	2
Spiritual Health	0	4	0	4
Suicide Self-Restraint	0	13	2	15
Thermoregulation: Peds	0	2	0	2
Total	1340	713	292	2345

NIC Interventions in Three ICUs	ICU type			Total
	SICU	MICU	CVICU	
Pain Management	253	54	31	338
Fall Prevention	118	50	18	186
Skin Surveillance	109	6	20	135
Infection Protection	104	41	8	153
Ventilation Assistance	100	91	21	212
Infection Control	84	38	8	130
Teaching: Procedure/Treatment	84	26	26	136
Airway Management	80	57	20	157
Airway Suctioning	79	57	17	153
Acid-Base Management: Respiratory Acidosis	78	64	19	161
Pressure Management	73	3	3	79
Wound Care	73	1	1	75
Acid-Base Management	63	41	32	136
Teaching: preoperative	56	2	22	80
Energy Management	42	24	27	93
Exercise Promotion: Strength Training	42	20	10	72
Analgesic Administration	38	16	4	58
Activity Therapy	37	19	11	67
Exercise Promotion	35	7	0	42
Neurologic Monitoring	34	7	0	41
Teaching: Disease Process	32	18	6	56
Aspiration Precautions	30	14	2	46
Anxiety Reduction	27	37	10	74
Cerebral Edema Management	27	1	0	28
Cerebral Perfusion Promotion	27	3	0	30
Sleep Enhancement	26	1	0	27
Nausea Management	23	7	1	31
Delirium Management	21	8	0	29
Circulatory Care: Arterial Insufficiency	19	8	4	31
Circulatory Care: Venous Insufficiency	18	7	4	29
Temperature Regulation	16	11	2	29
Seizure Precautions	15	0	0	15
Bowel Management	14	3	1	18
Diet Staging	14	3	1	18
Peripheral Sensation Management	14	0	0	14
Bleeding Precautions	12	35	2	49
Fluid Monitoring	12	14	3	29
Nutrition Management	11	19	3	33
Nutrition Therapy	10	19	3	32
Active Listening	9	1	1	11
Cognitive Restructuring	9	16	2	27
Cognitive Stimulation	9	5	5	19
Cardiac Care, Acute	8	13	31	52
Pressure Ulcer Care	8	3	3	14
Communication Enhancement: Speech Deficit	7	1	1	9
Coping Enhancement	6	35	4	45
Artificial Airway Management	5	4	1	10

Fluid Management	5	33	13	51
Urinary Retention Care	5	0	0	5
Self-Care Assistance	4	3	0	7
Constipation/Impaction Management	3	2	0	5
Positioning	3	4	0	7
Seizure Management	3	0	0	3
Substance Use Treatment: Alcohol Withdrawal	3	5	1	9
Communication Enhancement: Visual Deficit	2	0	0	2
Memory Training	2	0	0	2
Nutritional Monitoring	2	4	1	7
Unilateral Neglect Management	2	2	0	4
Breastfeeding Assistance	1	0	0	1
Emotional Support	1	1	0	2
Environmental Management	1	4	0	5
Exercise Therapy: Balance	1	0	0	1
Grief Work Facilitation	1	4	0	5
Health Education	1	0	0	1
Hypergylcemia Management	1	4	0	5
Hypoglycemia Management	1	4	0	5
Knowledge: Treatment Procedure	1	0	1	2
Latex Precautions	1	0	0	1
Mechanical Ventilatory Weaning	1	1	1	3
Mutual Goal Setting	1	3	1	5
Nutrition Support	1	0	1	2
Self-Responsibility Faciliation	1	6	2	9
Socialization Enhancement	1	1	0	2
Substance Use Treatment: Drug Withdrawal	1	2	1	4
Surveillance: Safety	1	0	0	1
Teaching: Individual	1	0	0	1
Behavior Management	0	2	0	2
Behavior Management: Self-Harm	0	29	3	32
Diarrhea Management	0	11	0	11
Dying Care	0	1	0	1
Family Process Maintenance	0	0	1	1
Family Support	0	4	0	4
Fluid Balance	0	1	0	1
Hallucination Management	0	1	0	1
Hope Inspiration	0	3	1	4
Mood Management	0	15	1	16
Oral Health Restoration	0	3	0	3
Reality Orientation	0	1	0	1
Risk Control: Hyperthermia	0	1	0	1
Self-Esteem Enhancement	0	1	0	1
Spiritual Growth Facilitation	0	1	0	1
Spiritual Support	0	3	0	3
Suicide Prevention	0	13	2	15
Total	2063	1083	418	3564

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