THE EFFECTS OF NURSE EDUCATION AND CERTIFICATION ON

HOSPITAL-ACQUIRED INFECTIONS

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ABSTRACT

Introduction: According to the Centers for Disease Control (CDC), there are approximately 1.7 million hospital acquired infections (HAIs) in the U.S. that lead to 99,000 deaths annually (2011). Recent studies have found that facilities with a greater prevalence of nurses prepared at the baccalaureate-level or higher positively impact patient outcomes, however HAIs are not addressed specifically.

Purpose: The purpose of this study was to investigate the effects of nurse education and certification levels on the incidence of HAIs. The hypothesis for this study was that intensive care units with a higher ratio of nurses that have an advanced education level (BSN-prepared or above) and unit-specific certifications (CCRN) would have lower incidence rates of HAIs, specifically Ventilator Associated Pneumonias (VAP), Central Line-Associated Bloodstream Infections (CLABSI), and Catheter-Associated Urinary Tract Infections (CAUTI).

Methodology: The National Database of Nursing Quality Indicators® (NDNQI®) collects unit-level data on hospital acquired infections and RN education and certification. Incidence rates of hospital acquired infections were collected from clinical data, and calculated as the number of infections divided by device days. The RN education and certification information was collected from the RN Survey. Using regression models on data from 2012, the effect of education and certification on infection rates in critical care units was examined.

Findings: The linear regression revealed that neither certifications nor education level were significant in the incidence of VAP. Overall, certifications had no significant relationship to the incidence rates of hospital acquired infections; however the regression showed that an increase in the ratio of BSN or higher-prepared nurses proved to be a significant predictor of increased incidence rates of both CLABSI and CAUTI.

Nursing Implications: By reviewing the results on nurse education and these specific patient outcomes, more research can be done to further analyze the relationship between them. Due to the increased exposure of this subject by the 2010 Institute of Medicine "The Future of Nursing" report, the findings of this study could be used in the argument of evidence based findings that lead to the committee's recommendation to increase BSN-prepared nurses to 80 percent by 2020.

Disclosures: Research was sponsored by the NDNQI® under contract to the American Nurses Association.

INTRODUCTION

BACKGROUND ON NURSE EDUCATION AND CERTIFICATION

In "The Future of Nursing" report by the Institute of Medicine (IOM), the committee addressed

the need for highly-educated nurses. According to the report, with the shift of patient ailments to

include more chronic conditions nurses must revamp their education. This means that nursing

education needs to include components such as health policy, evidence-based practice, community

and public health, leadership, and teamwork and collaboration. In order to achieve this, the IOM committee recommended that "the proportion of nurses with baccalaureate degrees be increased to 80 percent by 2020" (Institute of Medicine [IOM], 2010, p. 4).

Many studies have been conducted trying to link positive patient outcomes to the level of education of the staff. In a 2011 article, it was found that the effect of only 10% more baccalaureate degree nurses would decrease the odds of mortality and failure-to-rescue in all hospitals studied by approximately 4% (Aiken, Cimiotti, Sloane, Smith, Flynn & Neff, 2011). Additionally, a study by Chang and Mark (2009) found that increasing the ratio of baccalaureate nurses showed a decrease in severe medication errors that could result in patient harm. Although, this decrease in errors was only seen until the percentage of baccalaureate nurses reached 54%.

In addition to education, certification has also been a popular topic for nurses as they find themselves getting certified to practice specialized skills and patient care. Certification provides a validation that the nurse has gone through the proper training and education and is competent in the specialized knowledge, skills and experience (American Association of Critical-Care Nurses, 2002). With the IOM report and this knowledge about certifications in mind, many studies have found that facilities with a greater prevalence of nurses prepared at the baccalaureate-level or higher positively impact patient outcomes; however, hospital acquired infections have not been addressed specifically.

BACKGROUND ON HOSPITAL ACQUIRED INFECTIONS

According to the CDC, there are approximately 1.7 million hospital acquired infections (HAIs) in the United States each year. These preventable infections lead to an average of 99,000 patient deaths and around $20 billion in healthcare costs annually (Centers for Disease Control and

Prevention [CDC], n.d., p. 1). The three HAIs that this study analyzed were ventilator-associated pneumonia, central line-associated bloodstream infections, and catheter-associated urinary tract infections. The CDC provides detailed definitions of the infections and how they are able to develop in patients in the hospital setting.

VENTILATOR-ASSOCIATED PNEUMONIA (VAP).

VAP is a pulmonary infection that develops in a patient who is receiving therapy from a mechanical ventilator. The mechanical ventilator improves the patient's breathing capability by supplying oxygen through an endotracheal tube that is placed in the patient's nose (nasal), mouth (oral), or through a surgical incision in the patient's neck (tracheostomy) (CDC, 2012). Infection can arise in these patients due to microorganisms being introduced in the lungs via the endotracheal tube. The use of mechanical ventilators increases the chances of developing pneumonia by 6-21 times versus patients without a ventilator. Because of this, it is mostly seen in intensive care units and actually makes up around 27% of hospital acquired infections in the intensive care setting (Chulay, 2008).

CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS (CLABSI)

Many patients in intensive care units, as well as other units in a hospital setting, have the need for a central line. Central lines are tubes "placed into a patient's large vein, usually in the neck, chest, arm, or groin" that can be used to draw blood and give intravenous medications and fluids (CDC, 2012). These lines are usually put in place for a longer period and are more invasive than the common IV. Infection can occur more easily in a central line due to the invasiveness and the ability for microorganisms to travel through the line and into the bloodstream. When a

bloodstream infection is caused by this, it is identified as a central line-associated bloodstream infection, or CLABSI.

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS (CAUTI).

CAUTIs develop in patients that have a foley catheter placed. A foley catheter is a tube that goes into the bladder and is commonly used to measure the strict urinary output that can aid in the assessment of kidney function. Urinary tract infections can involve "any part of the urinary tract, including urethra, bladder, ureters, and kidney" (CDC, 2012). These infections can be due to unsterile technique while inserting the foley catheter or the introduction of microorganisms through the tube. This kind of infection is unfortunately common in patients with urinary catheters and comprises 40% of all hospital acquired infections (Wound Ostomy and Continence Nurses Society, 2008)

STUDY AIMS

The purpose of this study was to investigate the effects of nurse education and certification levels on the incidence of hospital acquired infections. The hypothesis for the study was that intensive care units with a higher ratio of nurses that have an advanced education level (BSN-prepared or above) and unit-specific certifications (CCRN) have lower incidence rates of VAP, CLABSI, and CAUTI.

METHODS

DATA AND SAMPLE

The data for this study were collected on the unit level from the National Database of Nursing Quality Indicators® (NDNQI®). The NDNQI collects data on the incidence rates of ventilator-

associated pneumonia, central line-associated bloodstream infections, and catheter-associated urinary tract infections from clinical data and incidence rates are calculated as the number of infections divided by device days. The RN education and certification information is also collected on the unit level from the RN Survey. The RN Survey looks at the nursing characteristics of the hospital unit, part of which asks the nurse to provide their highest level of education and any certifications granted by a nationally accredited nursing organization. The 2012 dataset used in this study was gathered by the NDNQI and included 679 critical care units from around the country that had data for the percent of BSN-prepared nurses or higher and at least one of the infections analyzed in this study.

CONTROL VARIABLES

The control variables of this study were divided into two categories, hospital level controls and unit level controls. The hospital level controls included the teaching status and bed size of the hospital. Teaching status was broken up into three sections, Academic Medical Center, Teaching Hospital, and Community Hospital. Bed size went from <100, 100-199, 200-299, 300-399, 400-499, and >500. The unit level control variables included staffing and skill mix. Staffing was calculated by the RN hours per patient day (RNHPPD). RNHPPD measures the supply of nursing relative to the patient workload (National Database of Nursing Quality Indicators, 2012, p. 8). Skill mix was analyzed by the combination of different categories of workers (RNs, LPNs, UAPs) that are employed for the provision of care to patients.

DATA ANALYSIS

The NDNQI has adapted the Donabedian's conceptual framework of identifying the effects of structures and processes on outcomes into their approach of data collection (Montalvo, 2007, p.

1). This study examined a portion of the framework by observing the influence of structural indicators on patient outcomes. In order to evaluate the relationship that education and certification has on the incidence rates of the three HAIs, a linear regression model was used to analyze to the 2012 dataset.

RESULTS

CHARACTERISTICS OF DATA SET

Descriptive statistics of the control variables were performed. Teaching status put the data into three categories, with a majority of critical care units being from community hospitals (46%), a little over a third from a teaching hospital (36%), and the minority at academic medical centers (18%). The units showed considerable variability in the bed size of the hospitals. The results showed that 12.1% had fewer than 100 beds, 19.4% had 100-199 beds, 27.1% had 200-299 beds, 16.5% had 300-399 beds, 9.0% had 400-499 beds, and 15.9% had equal to or more than 500 beds (Table 1).

TABLE 1 SAMPLE BED SIZE STATISTICS

Category	Bed Size	Valid Percentage
1	<100	12.1%
2	100-199	19.4%
3	200-299	27.1%
4	300-399	16.5%
5	400-499	9.0%
6	≥500	15.9%

Staffing, in the form of RNHPPD, was evaluated from the 679 critical care units in the dataset. The mean RNHPPD was around 15. This means that out of the 24 hours in a day, on average the nurses were giving direct patient care for 15 hours. The analysis of the skill mix of the units showed that on average 90.4% of the staff on the intensive care units were Registered Nurses. There was some variability on this descriptive ranging from 63.7% to 100% of staff being RNs.

RN EDUCATION AND CERTIFICATION RELATIONSHIP WITH HOSPITAL ACQUIRED INFECTIONS

Ventilator-Associated Pneumonia. There were 589 units from the dataset that had data on both RN education and certification and VAP. The percent of nurses certified showed no significant relationship with the incidence rates of VAP (β = -0.033, p = 0.445). The percent of RNs with an education level of baccalaureate or higher also showed no significant relationship with VAP rates (β = 0.003, p = 0.942).

Central Line-Associated Bloodstream Infections. The effects of RN education and certification on central line-associated bloodstream infections were also examined. Out of the dataset there were 666 critical care units that had data on both RN education and certification and CLABSI incidence rates. The results showed no significance in the relationship between RN certification and CLABSI rates (β = -0.074, p = 0.065). However, the percentage of nurses that held a baccalaureate degree or higher did show significance with the CLABSI incidence rates (β = 0.123, p = 0.006). From the results of this regression model, a significant relationship can be seen between a higher ratio of baccalaureate-prepared nurses and a higher ratio of CLABSI rates.

Catheter-Associated Urinary Tract Infections. The final regression model examined the relationship between RN education and certification and CAUTI rates on 567 critical care units. The percent of RN certifications showed no significance with the incidence rates of CAUTIs (β = -

0.052, p = 0.210). When analyzing the percent of RNs with a baccalaureate degree or higher, the results showed significance in the incidence rates of CAUTI (β= 0.114, p = 0.013). Like the results from the CLABSI, it was found that higher RN education level had a significant relationship with higher incidence rates of CAUTI.

DISCUSSION

The results found from this study did not support the hypothesis that higher RN education and certification levels would result in a significant decrease in negative patient outcomes such as HAIs. In all three of the regression models for the HAIs, none resulted in any significant relationships between certification of the nurses on the units and HAI rates. Because of this, more research is still needed on the subject of nurse certifications and its impact on patient outcomes. The results of this study have also shown that having a higher ratio of baccalaureate or higher-prepared nurses is associated with higher incidence rates of CLABSI and CAUTI.

LIMITATIONS

One of the limitations of this study is related specifically to the fact that this was a secondary analysis rather than experimental data. Because of this, no actual causality can be predicted. Another limitation of this study was that the data was collected solely from facilities that participate in NDNQI®; therefore the facilities in the sample are not representative of all hospitals. In addition to this, the sample was only taken from intensive care units, which is not representative of all units in all hospitals.

Some limitations that could have precipitated the results showing higher RN education has a significant relationship with increased CLABSI and CAUTI rates were also examined. The first limitation hypothesized was that there is no risk-adjustment for patient acuity. The infection rates

are greatly influenced by patient acuity on the unit, and that could alone overwhelm any other potential predictors of unit differences, like RN education. Secondly, there could have been a more significant variable that was not controlled for that is causing the inverse relationship. In addition, this study treated the variables as continuous and linear, even though there were a large proportion of units that had zero infections so the distribution of the data is non-normal. To help correct this last issue, another analytic approach could be used on the data.

NURSING IMPLICATIONS

The purpose of this study was to find a correlation between nurse education and certification on hospital acquired infections. By reviewing the results on nurse education and these specific patient outcomes, more research can be done to further analyze the relationship between them. Due to the increased exposure of this subject by the 2010 Institute of Medicine "The Future of Nursing" report, the findings of this study could be used in the argument of evidence based findings that lead to the committee's recommendation to increase BSN-prepared nurses to 80 percent by 2020.

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