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Catheter-Associated Urinary Tract Infection in New York and North Carolina

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Abstract

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Dissertation Submitted in Partial Fulfillment

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Abstract

In the United States, many hospitalized patients with indwelling urinary catheters acquire catheter-associated urinary tract infections (CAUTI) during their hospital stay. CAUTI negatively affects peoples' health and quality of life and causes a financial burden to individuals and the nation. The purpose of this quantitative cross-sectional study was to explore the relationship between gender, age, and hospital types and CAUTI incidence in New York and North Carolina over a 3-year period. The theoretical framework of choice was the Donabedian model. Simple logistic regression and hierarchical multivariable logistic regression analysis were performed on archival data that was requested from Healthcare Cost and Utilization Project (HCUP) agency. According to the findings, males (n = 61,040) were at a higher risk of developing CAUTI compared to female (n = 66,792) ($p < .001$) in New York and North Carolina between 2012 and 2014. The odds of getting CAUTI were much higher among age > = 45 compared to the < 17 years. These findings fit in with previous literature identifying age and gender as having a significant relationship with CAUTI occurrence. The outcomes in this study may guide the formulation of policies that are age-appropriate, gender-specific, and facility-tailored to reduce the incidence of CAUTI.

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Dedication

I dedicate this capstone project to my God, my creator who makes all things possible for me, the source of my strength, and guidance for my journey forward. I also dedicate this project to my father Pa Oyedotun James Folayan of blessed memory and my mother Madam Eniola Esther Folayan (Nee Ekunola) who's commitment in providing formal education for their children including me has brought me this far in my education.

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Chapter 1: Introduction to the Study

Urinary tract infection (UTI) is caused by disease-causing organisms in the ordinarily sterile urine or tissues of the genitourinary tract involving the bladder, the kidneys, and urethra (Center for Disease Control and Prevention [CDC], 2015). When UTI results from the introduction of an indwelling catheter into the bladder for urine drainage, the diagnosis is called catheter-associated urinary tract infection (CAUTI; CDC, 2015). The CDC (2015) defined CAUTI as clinical symptoms and laboratory evidence of UTI in a patient who has had an indwelling urethral catheter in place for more than 2 days. Patients with CAUTI feels ill; have a temperature; rigidities; change in mental status; weakness; flank pain; and an unset of blood in urine, pelvic pain, and difficulty or frequent urination, or suprapubic pain or tenderness. CAUTI is clinically diagnosed by =>103 colony forming units (cfu)/mL of => to bacterial species in a single catheter urine specimen or in a midstream-voided urine specimen from a patient whose urethral, suprapubic, or condom catheter has been removed within the previous 48 hours. Patients in health care facilities such as acute care hospitals, surgical centers, end-stage renal disease facilities, long-term care facilities, nursing homes, and rehabilitation centers that have an indwelling urinary catheter inserted are at risk of developing CAUTI (Weber et al., 2011).

Some patients require the insertion of the indwelling urinary catheter for medical treatments. Magill et al. (2014) found that 23.6% of 183 surveyed U. S. hospitals use indwelling urinary catheter during patient care. In 2011, National Healthcare Safety Network (NHSN) reported that 45–79% of patients in adult critical care units had an indwelling catheter. Dudeck et al. (2013) claimed that 17% of patients receiving an indwelling urinary catheter are in medical wards, 23% in surgical units, and 9% on rehabilitation departments.

The disease-causing microorganisms associated with CAUTI include bacteria, fungi, viruses, and other pathogens, and the insertion of a urinary catheter is one of the risk factors of CAUTI(Carter, Reitmeier, & Goodloe, 2014). The infectious agents migrate into the bladder through the catheter tubing that as a result of the improper insertion of the catheter, obstruction of the flow of urine, or accumulation of urine in the bladder that increases the growth of microorganisms (Carter et al., 2014).

CAUTI is the most frequently seen hospital-acquired infection (HAI) in the United States with approximately one in every five patients admitted to an acute care hospital who had an indwelling urinary catheter (Saint, Meddings, Calfee, Kowalski, & Krein, 2009). More than 12% of adult hospital inpatients have an indwelling urethral catheter during their hospital stay, and indwelling urethral catheters account for 70%-80% of UTI with a daily risk of 3% to 7% CAUTI (Weber et al., 2011; Weinstein et al., 1999).

In Chapter 1, I addressed the background of CAUTI, the purpose of the study, research questions and hypotheses, theoretical framework, and the nature of the study. This chapter also includes an overview of the study, assumptions, scope, limitations, delimitations, the significance of this research study, and implications for positive social change.

Background

CAUTI is a HAI that continually challenges the quality of health care services despite the increasing evidence that CAUTI is preventable with the use of evidence-based practices (Umscheid et al., 2011). From 1990 to 2002, CAUTI accounted for 32% of all HAIs, making it the most frequent type of infection experienced in the hospital with approximately 449,000 CAUTI incidences at an estimated cost of $450 million yearly in the United States (Klevens et al., 2007). According to the CDC (2012), 15% -25% of hospitalized patients receive indwelling urinary catheters during their hospital stay, and 75% of acquired UTIs in the hospital are associated with an indwelling urinary catheter. Two-thirds of patients in intensive care units and one-fifth of patients on medical-surgical units have indwelling urinary catheters during their hospital stay (Dudeck et al., 2011).

The CDC also estimated that 600,000 hospital patients develop UTI annually with 80% being CAUTI and complications including secondary bloodstream infections, a 10% mortality rate, and increased number of hospital days stay by 2-4 days, and antimicrobial overuse (Campbell, & Moore, 2016). HAIs including CAUTI in North Carolina cost $124-$348 million each year in direct expenditures (Anderson, Pyatt, Weber, Rutala, & North Carolina Department of Public Health HAI Advisory Group, 2013).

According to the 2012, 2013, and 2014 CDC Hospital Acquired Infection (HAI) Progress Report, there was a 3% increase in CAUTI between 2009 and 2012, with 16 states performing worse than the national standardized infection ratio (SIR). Table 1 below shows the comparison of CAUTI's SIR for New York and North Carolina with the national SIR in 2012, 2013, and 2014.

Table 1

Progress Report of CAUTI's SIR in New York and North Carolina Compared to the National SIR CAUTI Incidence in 2012, 2013, and 2014

State	Year	Number of Reporting Hospitals	National SIR	State SIR	State SIR vs National SIR
New York	2012	175	1.03	1.36	36%
	2013	153	1.06	1.26	26%
	2014	149	1	1.15	15%
North Carolina	2012	100	1.03	1.09	9%
	2013	77	1.06	1.14	14%
	2014	79	1	1.22	22%

Note. Progress report of healthcare associated infections (CDC 2012, 2013, and 2014). Adapted from National and State Healthcare Associated Infections Progress Report published in 2014, 2015 and 2016.

The National and State Healthcare-Associated Infections Progress Report (2014, 2015, 2016) noted a 36%, 26%, and 15% higher than the national CAUTI SIR in 2012, 2013, and 2014 respectively in New York hospitals. The CDC (2014, 2015, 2016) indicated a 9%, 14%, and 22% higher than the national CAUTI SIR in 2012, 2013, and 2014 respectively compared to the national SIR in North Carolina hospitals, as shown in Table 1. According to the New York State Department of Health (2013), there was a 56% urinary indwelling catheter use in intensive care unit patients; 13% of urinary indwelling catheters in the medical and surgical wards resulted in CAUTI at a rate of 2.6 infections per 1,000 catheter days.

In the United States, about 50% of intensive care units do not have written policies and protocols for the insertion of urinary indwelling catheters (Conway, Pogorzelska, Larson, & Stone, 2012). There should be policies on using portable bladder ultrasound scanners, condom catheters for men with urinary incontinence, patient reminders, or regular stop orders to prompt the removal of indwelling catheters (Conway et al., 2012). Consequently, it has been a challenge to reduce CAUTI nationwide. There is a need to develop effective policies and procedures for the prevention of CAUTI.

The Center for Medicare and Medicaid Services (CMS), CDC, the Healthcare Infection Control Practices Advisory Committee (HICPAC), and the Joint Commission's 2012 National Patient Safety Goals identified evidence-based practices to reduce the occurrence of CAUTI. In 2013, the department of health and human services (DHHS) reported a 9% increase in CAUTIs between 2010 and 2013. In an effort to reduce CAUTI, the CMS has increased penalties for health care facilities with CAUTI incidences.

Problem Statement

On a national level, CAUTI is the most common HAI in the United States (Conway & Larson, 2012; Dudeck et al., 2013). Almost 25% of hospitalized patients receive indwelling urinary catheters during their hospital stay (CDC, 2013a). About 75% of UTIs occur in 15-25% of hospitalized patients who receive indwelling urinary catheters during their hospitalization (CDC, 2013a). CAUTI is responsible for 35% to 40% of HAIs in the United States, and it costs health care organizations between $150 and $450 million annually (Institute for Healthcare Improvement, 2011).

In New York and North Carolina, health care facilities continue to have higher numbers of CAUTI than the national baseline and hospitals. Both states reported higher

CAUTI rates between 2012 and 2014 compared to the national SIR (CDC, 2012, 2013, 2014). CAUTI affect the quality of life of patients. It causes burning or pain in the lower abdomen, fever, burning sensation during urination, or an increase in the frequency of urination (CDC, 2013a). CAUTI also increases the cost of health care services, length of hospital stays, and the number of deaths during and after a hospital stay. There is also the risk of antimicrobial resistance and Clostridium difficile infection in acute care facilities when there is an improper management of CAUTI (Trautner et al., 2009). The risk of infection increases 3% to 5% each day an indwelling catheter remains in a patient with a 0.5 to 1.0 extended hospital day (Institute for Healthcare Improvement, 2011). There has not been a study conducted on the factors that influence the incidence of CAUTI in New York and North Carolina in 2012 to 2014, thus revealing a gap in the literature.

Purpose of Study

The goal of this study was to explore the relationship between CAUTI and gender, age, and hospital types in New York and North Carolina over a 3-year period of 2012, 2013, and 2014. Data was collected from HCUP agency and was analyzed using a quantitative cross sectional research method to accomplish this goal.

Research Questions and Hypotheses

The following three research questions informed this study:

RQ 1: Is there any significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014?

$H_0 1$: There is no significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a1: There is a significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: gender
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 2: Is there any significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014?

H_02: There is no significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a2: There is a significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: Age
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 3: Is there any significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014?

H_03: There is no significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a3: There is a significant relationship between hospital types categorized as government-owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number CAUTI
- Independent variable: Hospital types (government-owned, private nonprofit, and private for profit).
- Analysis: analysis of CAUTI occurrences by hospital type reported in New York and North Carolina between 2012 and 2014.

Theoretical Framework

The theoretical foundation upon which this study was based was the Donabedian theory. This framework model has been used in health care service research to determine the elements relevant to patients' care quality (Aday, Begley, Lairson, & Balkrishnan, 2004). The Donabedian model is appropriate for this study because the model may be used to explain how structure and process in each state, city, or jurisdiction could determine the incidence of CAUTI outcome.

The first component of the Donabedian model is the structure. The structure comprises all factors that affect the context of health care delivery and the physical aspects of the organizational care settings (McDonald et al., 2007). The second part, the process, consists of all actions that constitute health care delivery systems. The third element, the outcome, refers to the effects of health care on the status of patients or populations.

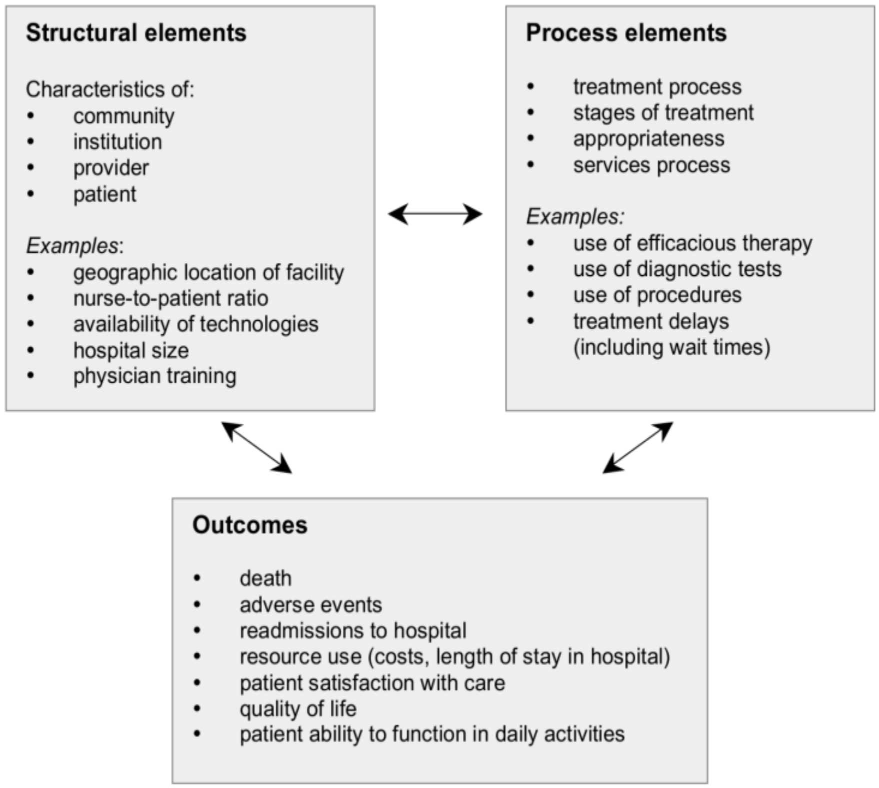

Figure 1. Donabedian's model for quality assurance (Aday, Begley, Lairson, & Balkrishnan, 2004). Adapted from Donabedian, 2003.

Nature of the Study

The Donabedian model provided the framework in this quantitative, cross-sectional research method. The appropriateness in the choice of quantitative research method stems from its extensive applicability, as well as its detailed presentation of statistical descriptions of trends, opinions, and measures the level of occurrence of an event (Creswell, 2014).

The dependent variable was CAUTI occurrences, and the independent variables were gender, age, and hospital types namely government-owned, private nonprofit, and private for-profit. Secondary data collected from HCUP were used to examine the relationship between the occurrence of CAUTI and gender, the age of the patients, and hospital types in acute care facilities in New York and North Carolina in 2012, 2013, and 2014. The literature review, theoretical framework, and statistical analysis were conducted to determine if there was a significant relationship between the dependent variable -CAUTI- and the independent variables of age, gender, and hospital types in New York and North Carolina from 2012 to 2014.

Definitions and Key Terms

Acute care hospitals: Healthcare facilities that deliver care at an individual or population level in a time sensitive manner and performed rapidly to promote health and provide treatment. The patient receives active but short-term treatment for a severe injury or episode of illness, an urgent medical condition, or during recovery from surgery.

Age: *The* patient age in years as calculated by the admission date to the hospital.

Agency for Healthcare Research and Quality (AHRQ): A U.S. government agency that functions as a part of the Department of Health & Human Services (HHS) to support research to help improve the quality of health care.

Catheter-associated urinary tract infection (CAUTI): *A* UTI that occurs by the introduction of a catheter(s), or tubes, placed in the urethra and bladder.

Discharges: The unit of analysis for HCUP data is the hospital discharge (i.e., the hospital stays), not a person or patient. An individual who is admitted to the hospital multiple times in 1 year will be counted each time as a separate discharge from the hospital.

Gender: *Patient* sexual orientation coded as male or female at the time of admission.

Healthcare Cost and Utilization Project HCUP): The nation's most comprehensive source of hospital data.

Hospital-acquired infection (HAI): HAIs are diseases that develop in hospital patients' after 48 hours of stay or within 30 days of release.

Hospital types: *Categories* as government owned (public), private not-for-profit (voluntary) and private investor-owned (proprietary).

International Classification of Diseases - 9th Revision - Clinical Modification (ICD-9-CM): *All* diagnoses (or conditions) and all procedures that patients receive in the hospital are assigned an ICD-9-CM code. Codes for diagnoses can be up to five digits long, and codes for procedures can be up to four digits long.

The National Healthcare Safety Network (NHSN): The NHSN is the United States' most widely used health care-associated infection tracking system. Since 2009, infection data have been reported to the NHSN to track the national progress of the reduction of HAIs. The NHSN is a secure, Internet-based national data reporting system that New York State (NYS) hospitals must use to report HAIs. The NHSN is managed by the CDC's Division of Healthcare Quality Promotion.

Nosocomial urinary tract infection: *A* disease of the UTI that develops in patients while in health care facilities.

New York: New York in this study refers to the New York State and not New York City.

Standardized infection ratios (SIR): The primary summary measure used by the National Healthcare Safety Network (NHSN) to track HAIs. SIR is calculated by the number of observed infections divided by the number of predicted infections.

Urinary tract infection (UTI): *A* disease of one or more of the urinary tract structures namely the kidneys, ureters, bladder, or urethra.

Assumptions

The following were the assumptions made for this study: I adopted the structural settings of the organizational resources. These resources included the facilities, equipment, money and, human resources as in health care workers and of organizational configuration as in medical staff organization, methods of peer review, and methods of reimbursement (Donabedian, 2005). The process elements are the care services rendered and received, including patients' activities toward care that could be influenced by age, and gender, and caregiver activities, such as diagnosis and recommending or implementing treatment (Donabedian, 2005). The outcome elements addressed how a patient's health status is affected or influenced. Health status included patient satisfaction, health improvement, and the patient's knowledge of constructive changes in the patient's behavior.

Donabedian (2005) explained that health care providers include skilled workers, financial resources, and administrative setting. The skills, proficiencies of the system's administration policies, and clinical processes requires proper considerations because of its influence on the patient's outcome (Campbell, Roland, & Buetow, 2000). Donabedian also assumed that the organization's mission, vision, philosophy, beliefs and values, employee motivation, and leadership skills and attributes contribute to the structure, process, outcome model (Glickman, Baggett, Krubert, Peterson, & Schulman, 2007).

This study was based on data collected by the HCUP, which contains the most extensive collection of longitudinal hospital care data in the United States. The medical database is developed through a federal-state-industry partnership and is sponsored by the

AHRQ. The HCUP database comprises data from states, organizations, hospital associations, private organizations, and the federal government to create a national information resource of encounter-level health care data.

Scope and Delimitations

In this study, I addressed the research questions concerning the possible relationship between CAUTI and age, gender, and hospital types. The population of the study included patients diagnosed with CAUTI during their hospital stay in New York and North Carolina from 2012 to 2014. Delimitations of a study are characteristics that limit the scope of the inquiry as determined by the conscious exclusion and inclusion decisions made during the process of the research (Mitchell, Wirt, & Marshall, 1986). A delimitation of this study was the use of secondary data collected and published by the HCUP; the analyses were performed on data from New York and North Carolina. Given the nature of the study and characteristics of the data available, a quantitative perspective was undertaken. Finally, findings from the study were generalizable to only the states specified in this study.

Strengths and Limitations

One of the strengths of this study lies in the research method. The cross-sectional study provided a snapshot of the frequency of CAUTI in the population considered at a given point in time. The sample size was sufficient to estimate the prevalence of the conditions of interest with adequate precision.

One of the limitations of this study was the use of secondary data collected for other purposes; moreover, the data on one of the independent variables were not available in the format that could be analyzed via statistic testing. Although it may be appropriate to generalize findings to other states in the country, it may not be prudent to generalize outcomes to all states. There could be significant microcultural differences in other states that could directly affect the results of the study. There could also be factors associated with CAUTI that were not known at the time of the study and may affect the outcome of the study. Therefore, data accuracy is assumed but may limit the interpretation of the findings.

Significance

In October 2016, the U.S. HHS announced new targets for the national acute care hospital metrics to prevent HAI that included a reduction of CAUTI in intensive care units and ward-located patients by 25%. As shown in Table 2, CAUTI had not changed since the last target goal was made in 2013, and CAUTI was the least-expected reduction goal for the new target set for 2020 by the CDC as shown in Table 3. This research has provided statistical information on the relationship between CAUTI and each of age, gender, and hospital type that could be helpful in solving the problem of CAUTIs' frequent occurrence in acute care settings. This research fills the gap in the literature regarding the lack of study of the possible relationship between CAUTI and age, gender, and hospital types categorized as government owned, private not-for-profit, and private for-profit. This study was intended to increase awareness among all health care providers in New York and North Carolina regarding the need to implement effective evidence-based practices related to indwelling catheterization of patients. The findings from this study may be used to formulate policies within health care facilities to reduce and to possibly eliminate CAUTI in these two states.

Table 2

Prevention of HAI Targets and Progress Made by 2014 as Reported by the CDC

Measure (and data source)	Original target for 2013 (from 2009 baseline)	Progress made by 2014
CLABSI (NHSN[1])	50% reduction	50% reduction
CAUTI (NHSN)	25% reduction	No change
Invasive MRSA (NHSN/EIP)	50% reduction	36% reduction
Facility-onset MRSA (NHSN)	25% reduction	13% reduction
CDI (NHSN)	30% reduction	8% reduction
SSI (NHSN)	25% reduction	18% reduction
Clostridium difficile hospitalizations (HCUP[2])	30% reduction	18% increase

Table 3

New Targets set for 2020 by the CDC

Measure (and data source)	2020 Target (from 2015 baseline)
CLABSI (NHSN)	50% reduction
CAUTI (NHSN)	25% reduction
Invasive MRSA (NHSN/EIP)	50% reduction
Facility-onset MRSA (NHSN)	50% reduction
CDI (NHSN)	30% reduction
SSI (NHSN)	30% reduction
Clostridium difficile hospitalizations (HCUP)	30% reduction

Note: Improve patient safety DHHS, 2013). Adapted from the Office of Disease Prevention and Health Promotion, Office of the Assistant Secretary for Health, Office of the Secretary, U.S. Department of Health and Human Services

As indicated in Table 3 above, the new targets start from an updated baseline and, in some cases, are more aggressive than the previous goals.

Summary

The insertion of an indwelling urinary catheter for and during medical treatment is an unavoidable invasive procedure in health care facilities. Patients who have indwelling urinary catheter are exposed to acquiring UTIs as a result of factors such as improper insertion procedure and management of the catheter; hence, there is the concern for patient safety. The knowledge of significant factors that influence CAUTI in New York and North Carolina might trigger more research that may result in creating effective policies for the reduction and elimination of CAUTI in these two states. In this chapter, I focused on the background of the study, problem statement, and purpose of the study. This section included the research questions, associated hypotheses, theoretical framework for the study, a brief overview of the assumptions, scope, limitations, and delimitations. There were also discussions on the significance of this study, as well as the implications for positive social change. The detailed literature review is presented in Chapter 2.

Chapter 2: Literature Review

Introduction

With an annually estimated 2 million patients with HAI, reducing CAUTI is a patient safety issue that must be addressed by health care providers (CDC, 2013a). CAUTI in the United States is a significant health problem that continues to occur among males and females, various age groups, and regularly in health care facility types. Knowing the relationship between CAUTI and gender, hospital types, and age can help decrease HAI. However, this study was limited to researching statistical occurrence and possible reasons as to why the CAUTI persists; I did not compare geographic rates that are in proximity with the goal of determining if any significant factor exists that may be a common variable to the occurrence of CAUTI. In this chapter, I explain the literature search strategy used for the study, why the theoretical framework applies to the study, and the literature related to variables and concepts of the study.

Literature Search Strategy

In the literature review, I present a systematic and historical evaluation of the research on CAUTI using electronic databases such as the Cumulative Index to Nursing and Allied Health Literature (CINAHL) database PubMed, Ovid/MEDLINE, ProQuest, and the Cochrane Library. The keywords used in the search included *urinary tract infections,* and *indwelling urinary catheters*. Research criteria included published research in the English language describing experimental or observational studies and literature on current strategies and interventions to reduce or prevent hospital-acquired CAUTI. Exclusion criteria included publications on occasional catheterization, suprapubic, nephrostomy tubes, and noncatheter-related urinary tract infection (UTI). This literature review consists of the evaluation of recommended clinical practice guidelines within the last 5 years that apply to decreasing the occurrence of CAUTI.

Theoretical Foundation

The theoretical foundation for this study was the Donabedian model developed by Donabedian as a structure-process-outcome theory. The focus of this theory is on improving quality outcomes in health care facilities. The Donabedian framework is frequently used in the quality of care research. This framework is used to assess the quality of care because it is flexible for health care conditions, such as the use of indwelling urinary catheters to care for patients in health care facilities (Dimick, 2010). Donabedian (1980, 1990) included patients' satisfaction and other attributes that define the quality of health care.

Dimick (2010) explained that although there are different types of quality measurements, quality measures can be classified into one of Donabedian three dimensions to measuring health care quality. The model has been used in health care service research to determine the elements that are relevant to patients' care quality (Aday et al., 2004). The Donabedian model applies to this study because it can be used to explain how structure and process in each state, city, or jurisdiction could determine the outcome of health care services.

An organization with the right structure and process will produce a better outcome (Donabedian, 1985). The Donabedian model divides concepts into three components: structure, process, and outcome (Figure 1). The first element of the Donabedian model is the structure. The structure comprises all factors that affect the context of health care delivery and the physical aspects of organizational care settings (McDonald et al., 2007). Examples of the structure include; facilities, equipment, personnel, operational, and the financial processes that support health care delivery.

The second component, the process, consists of all actions that constitute health care delivery systems (Donabedian, 1985). The focus of the process is on the care delivered to the patient, the communication, and the collaboration between patients and health care providers (Donabedian, 2003). Examples of the process are services and treatments. Having the knowledge of the relationship between CAUTI, age, and gender may improve the interaction between patients and health care providers for a CAUTI-free stay in health care facilities.

The third component of the Donabedian model, the outcome, refers to the effects of health care on the status of patients or populations. Donabedian (2005) recognized that attempts to measure health care quality comes with challenges. One such problem was how to take into consideration the unique nature of the individual patient and the resultant complexities of tailoring care to accommodate the uniqueness of the patients. One attempt to take care of the uniqueness of care is to measure whether or not a minimum standard of care for the population is met rather than measuring quality on a continuum from weak to excellent. Donabedian specified two requirements in the model. First, there is the need to assess the interdependent influences of structure and process on the outcome, as well as to control the characteristics of the patient population during the delivery of care. Although some health care researchers believe that the Donabedian model may need revision, the model continues to help guide policymakers, quality measure developers, and users to improve health care outcomes (Dimick, 2010). There is need also to put the characteristics of patient population into perspective, as in male or female, children, adults, or the elderly when providing health care services (Dimick, 2010). I used the Donabedian platform to examine the relationship between CAUTI, age, gender, and hospital types in two states for a period of 3 years, 2012 to 2014.

Historical Background

One of the earliest reports on CAUTI dated back in 1883 with Clark's "catheter fever" findings. Clark discovered that healthy, middle-aged men with no prior disease were stricken by fever after the use of an indwelling urinary catheter, and some of them died. Levine (1964) established that using a urethral catheter is an established health risk device despite its usefulness. Stamm (1975) conducted research on more than 400,000 patients with an indwelling urinary catheter in the United States and showed that the most common HAI infection was CAUTI. Stamm indicated that CAUTI increases morbidity, extends hospital stay, increases the cost of hospitalization, and increases mortality as a result of Gram-negative septicemia. Indwelling urethra catheterization have also been associated with risks such as CAUTI; yet, Jansen et al. (2012) indicated that about 14–38% of the indwelling urethra catheters placed in hospitalized patients are inserted without a medical indication.

Pathogenesis

The source of the microorganisms causing CAUTI can be endogenous, typically via meatal, rectal, or vaginal colonization or exogenous (such as via equipment or the contaminated hands of health care personnel) (CDC, 2005). A urinary catheter provides a portal of entry into the urinary tract. Bacteria may ascend into the tract via the external or internal surface of the catheter. Characteristics of each method of ascension are identified below in Figure 2.

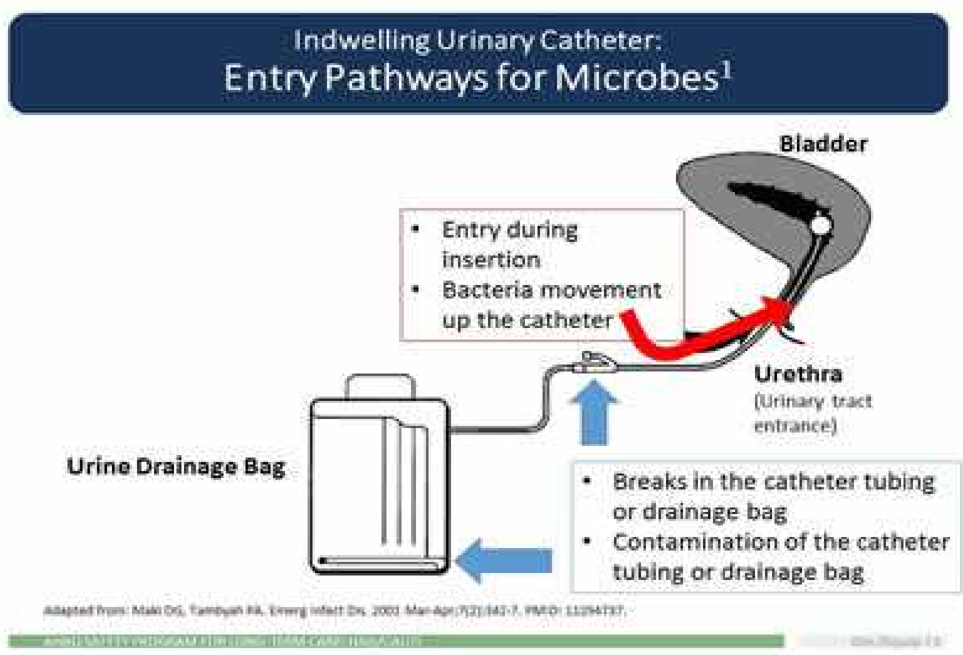

Figure 2. Diagram of the routes of entry of uropathogens to catheterized urinary tract. Adapted from Maki and Tambyah, *Emerg Infect Dis* 2001;7:1-6.

The insertion of the catheter into the bladder through the urethral may introduce pathogens into the bladder, and a contaminated drainage tube attached to the collection bag may serve as a source of the disease-causing microorganism to migrate into the bladder through the collection tube (Barford & Coates, 2009). The urine that remains in the bladder of catheterized patients encourages the pathogens to adhere to the epithelial cells of the urinary tract and the surface of the catheter. The surface of the catheter thus becomes resistant to the patient's immunity and antibiotics (Barford & Coates, 2009). The indwelling urinary catheter may irritate the epithelium of the bladder, resulting in inflammation and infection of the wall of the bladder. Other undesirable outcomes of indwelling urethral catheter include serving as a source of infection (especially after many days of the catheter in the bladder), nonbacterial urethral inflammation, urethral strictures, and mechanical trauma (Hooton et al., 2010).

Diagnosis

CAUTI is diagnosed when the signs and symptoms of UTI are present in patients with an indwelling urinary catheter with no other identified source of infection. There has to be more than 103 colony forming units (cfu)/mL equal or greater than one bacterial species in a single catheter urine specimen or a midstream voided urine specimen from a patient whose urethral, suprapubic, or condom catheter has been removed within the previous 48 hours (Hooton et al., 2010). A CAUTI patient does not show typical symptoms associated with UTI, such as dysuria, frequent urination, and urgent urination; yet, symptoms may occur after the removal of the indwelling urinary catheter (Tambyah & Maki, 2000). Signs and symptoms associated with CAUTI include high temperature, change in mental status, tiredness, side pain, sudden blood in urine, pelvic pain, and difficulty and pain with frequent urination in patients post indwelling catheterization (Hooton et al., 2010).

Risk Factors

The length of time that an indwelling urethral catheter remains in situ has been found to be a risk factor in the development of CAUTI. Frequent indwelling urinary catheter placement gender, age, and management closed drainage system increases the risk of CAUTI (Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2010). Disease comorbidity and measures (ie., neutropenia, renal disease, and gender) could contribute to CAUTI (Greene et al., 2012). There is a 3–7% daily risk of acquiring CAUTI when an indwelling urinary catheter is in place, and the risk is higher for women and older individuals (Hooton et al., 2010).

Alternatives to indwelling urethral catheterization include intermittent catheterization; suprapubic catheterization; and the use of external collection devices, including condom catheters, diapers, or pads. De Ruz, Leoni, and Cabrera (2000) indicated a decrease in the incidence of CAUTI among patients at the same institution with condom catheters or indwelling urethral catheters.

A suprapubic catheter is used for bladder drainage in patients with the benefit of decreasing CAUTI incidence, lowering the risk of urethral trauma and structure and allowing patients to try normal urination (Hooton et al., 2010). In a review of published studies comparing urethral and suprapubic catheters in patients undergoing colorectal surgery, Branagan and Moran (2002) showed that CAUTI was more prevalent in the patient with indwelling urethral catheterization along with more repetition of catheterization and discomfort. Comorbidity risk factors associated with CAUTI includes prolonged catheterization, use of systemic antibiotics, diabetes mellitus, higher risk compared to males, preexisting conditions such as malnutrition, and elevated creatinine (Nicolle et al., 2005).

Effects of Catheter-Associated Urinary Tract Infection

Clinical procedures and treatment interventions in hospitals have been associated with increased mortality rates in elderly patients with hospital-acquired CAUTI. A case-control study was done on 681patients 65years and above admitted during a 3-year period with hospital-acquired CAUTI; Schroeder (1998) showed a significant interaction between genitourinary disease and invasive treatment procedures. Hospital-acquired CAUTI was associated with an increased hospital stay and excess hospitalization costs postsurgical procedure as a result of an average of 2.4 more days in the hospital costing $558 per patient (Givens & Wenzel, 1980). Early detection and intervention in patients of advanced age with severe underlying and debilitating disease will reduce the effects of CAUTI on the patients, as well as the cost of treatment (Schroeder, 1998). The consequences of using indwelling urinary catheters include increased patient hospitalization from 11,742 in 2001 to 40,429 in 2010, a financial burden that has cost the United States $213 million to $1.3 billion in the same 10-year period (Colli, Tojuola, Patterson, Ledbetter, & Wake, 2014). The indwelling urinary catheter can cause medical complications such as septicemia, which increased from 21 % in 2001 to 40 % in 2010 (Colli et al., 2014).

Evidence-Based Practices to Decrease CAUTI

Recommended techniques and methods can be implemented to prevent CAUTI. Among these methods is employing computer technology to prompt health care providers' discontinued use of indwelling urinary catheter and infection control strategies such as proper hand washing and aseptic techniques (Rosenthal et al., 2012). All of these can factors be significant in the reduction of CAUTI if adequately implemented (Rosenthal et al., 2012).

Arcury et al. (2005) conducted an analytical study on the importance of geography and spatial behavior's influence on rural health care use, controlling for demographic, social, cultural, and health status factors. Arcury et al. used a 3-stage sampling design stratified by county and ethnicity. Arcury et al. showed continuing inequity in rural health care use that must be addressed in public policy.

More than 65% of CAUTI casa are preventable with current, evidence-based strategies using comprehensive application of guidelines, such as hand hygiene and proper aseptic insertion techniques (Umscheid et al., 2011). Clinical indications and patient factors (such as age, gender) and organizational factors (including facility resources and policy) are significant determinants of the use and management of indwelling urinary catheter (Murphy, 2014). Understanding interventions to reduce the initial placement of indwelling urinary catheters is substandard, and there is a lack of agreement on when the benefits of indwelling urinary catheter use outweigh the risks (Murphy, 2014). Patients in a medical intensive care unit who had indwelling urinary catheters showed a significant reduction in the incidence of CAUTI with a decrease in the length of days of an indwelling urinary catheter in the patient (Elpern et al., 2009).

Evidence-Based Practice (EBP) is the application of recently proven best methods of practices such as patient care in healthcare delivery. In medical care, EBP employs a clinical approach to solving the problem using research evidence with proven skill and patient-centered inclinations (Poilt & Beck 2012). EBPs have been proven to reduce and prevent CAUTI. Some studies have endorsed the early removal of urinary indwelling catheters to avert CAUTI occurrences. Bernard, Hunter, and Moore (2012) found that nurse-led or chart reminders to periodically assess the continued need of urethral indwelling did reduce the number of days of catheterizations, and consequently the incidence of CAUTI.

Lo et al. (2008) employed a pre-post intervention strategy to study the effect of number of catheter days and the incidence of CAUTI. EBP guidelines suggested by the Society for Healthcare Epidemiology of America (SHEA) and Infectious Disease Society of America (IDSA) was used to revise the hospital policy on the insertion and care of indwelling urinary catheters (Lo et al., 2008). The outcome of the study decreased the number of indwelling urinary catheter use days from 3.01 to 2.2 on the surgery unit and from 3.53 to 2.7 on the medical ward (Lo et al., 2008).

Clark et al. (2013) studied bundling interventions comprising four actions: the use of a securing device after indwelling catheter insertion, choosing silver alloy catheters, ensuring that catheter tubing is off the floor and removal of the indwelling urinary catheter by day two in postoperative patient. The result showed a clinically significant decrease in CAUTI (Clarke et al., 2013). CAUTI pre-intervention period decreased from 5.2 per 1,000 catheter days to 1.5 per 1,000 catheters days' post-intervention (Clarke et al., 2013).

Government Intervention to Decrease CAUTI

The CDC (2015) has surveillance processes associated with CAUTI that comprise specific criteria to detect and report CAUTI as well as required guidelines for caregivers.

CDC guidelines as listed in Table 4 include measures for using an indwelling urethral catheter on patients, insertion methods that should be employed to maintain indwelling urethral catheter, quality improvement programs, administrative infrastructure, and surveillance strategies (CDC, 2009). Category 1B is a strong recommendation supported by low quality evidence suggesting net clinical benefits or harms or an accepted practice (e.g., aseptic technique) supported by low to very low-quality evidence and I.B. Consider using alternatives to indwelling urethral catheterization in selected patients when appropriate.

Table 4

CDC-Appropriate Urinary Catheter Use Guidelines for Prevention of Catheter-Associated Urinary Tract Infections

#	Recommendation	Category
I.A.	Insert catheters only for appropriate indications (see Table 2 for guidance), and leave in place only as long as needed.	1B
I.A.1.	Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI or mortality from catheterization such as women, the elderly, and patients with impaired immunity.	1B
I.A.2.	Avoid use of urinary catheters in patients and nursing home residents for management of incontinence.	1B
I.A.2. a.	Further research is needed on periodic (e.g., nighttime) use of external catheters (e.g., condom catheters) in incontinent patients or residents and the use of catheters to prevent skin breakdown.	No recommendation/ unresolved issue
I.A.3.	Use urinary catheters in operative patients only as necessary, rather than routinely.	1B
I.A.4.	For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use.	1B
I.B.1.	Consider using external catheters as an alternative to indwelling urethral catheters in cooperative male patients without urinary retention or bladder outlet obstruction.	II
I.B.2.	Consider alternatives to chronic indwelling catheters, such as intermittent catheterization, in spinal cord injury patients.	II
I.B.3.	Intermittent catheterization is preferable to indwelling urethral or suprapubic catheters in patients with bladder emptying dysfunction.	II
I.B.4.	Consider intermittent catheterization in children with myelomeningocele and neurogenic bladder to reduce the risk of urinary tract deterioration.	II
I.B.5.	Further research is needed on the benefit of using a urethral stent as an alternative to an indwelling catheter in selected patients with bladder outlet obstruction.	No recommendation/ unresolved issue
I.B.6.	Further research is needed on the risks and benefits of suprapubic catheters as an alternative to indwelling urethral catheters in selected patients requiring short- or long-term catheterization, particularly for complications related to catheter insertion or the catheter site.	No recommendation/ unresolved issue

Note: Adapted from Centers for Disease Control and Prevention National Center for Emerging and Zoonotic Infectious Diseases (NCEZID) Division of Healthcare Quality Promotion (DHQP)

Effective from January 1, 2012, the Joint Commission established National Patient Safety Goal (NPSG) 07.06.01 to implement EBPs to prevent indwelling urinary CAUTI. The first recommendation is for healthcare facilities to have systems in place that assess the need for indwelling urinary catheter use to reduce its use. (The Joint Commission, 2012). The Institute of Healthcare Improvement recommended the use of aseptic techniques during insertion of indwelling urinary catheters.

In 2009, the CDC directed healthcare facilities to use indwelling urethral catheters for critically ill patients with acute urinary retention or bladder outlet obstruction. It is also recommended for patients undergoing surgery of the genitourinary tract when intake and urinary output measures are needed to enhance healing of open sacral or perineal wounds in incontinent patients. The use of indwelling urethral catheters is also recommended for patients who needs to remain immobilized for a long period of time and for improved comfort in end of life care. The CDC guidelines also direct that indwelling urethral catheter should not be used as an alternative for providing care for incontinent patients. It should not be used to collect urine for culture or other diagnostic tests in continents patients, and, for patients with a lengthy postoperative period, there must be appropriate indications for its use (CDC, 2009).

Organizational Approach to Decrease CAUTI

An administrative approach to reducing CAUTI has been proven to be effective. There is an emphasis on healthcare facilities to empower healthcare providers through education, and reminders to deliver excellent patient care to prevent CAUTI. The results of a study done in a neurological intensive care unit using hospital reminder systems, to stop orders, periodic assessment to evaluate indication for use, and staff education on indwelling urinary catheter care and insertion showed a 15% reduction in indwelling urinary catheter utilization (Underwood, 2015).

Hooton et al. (2010) recommended four effective performance measures that could guide healthcare facilities to achieve a reduction in morbidity and mortality associated with CAUTI. Healthcare institutions are advised to develop a list of appropriate indications for inserting indwelling urinary catheters, instruct staff on signs, and occasionally evaluate compliance with the institution-specific guidelines (Hooton et al., 2010). Organizations should ensure physician's order before an indwelling urinary catheter is placed on a patient and follow up with a periodical assessment of adherence to the qualification. Among the recommendations is the use of reminders or automatic stop orders to discontinue the use of indwelling catheter (Hooton et al., 2010).

Summary and Conclusions

The review of the literature on CAUTI reveals the early discovery of CAUTI as catheter fever, established as a health risk intervention that results in increased disease morbidity, and extended hospital stays for patients including more financial burden and possible death (Stamm, 1975). Pathogenesis indicates the introduction of disease-causing microorganisms into the urinary system (Barford & Coates, 2009). According to Gould et al. (2010), risk factors include gender, age, and management of a closed drainage system. Studies have been conducted to investigate best practice measures and clinical approaches using research evidence with proven skill and patient-centered inclinations to reduce CAUTI (Poilt & Beck 2012). Studies have been conducted on the national and international levels on CAUTI infection. This study is performed on a regional level for specific factors namely age, gender and hospital types that could influence CAUTI in two states.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to examine the association between CAUTI incidence and gender, age, and hospital types using data from the HCUP. In this chapter, I focus on the role of the researcher, the population of interest, the research method and design, data collection process, an outline of the data analysis method, and the reliability and validity of the study.

Research Design and Rationale

The research design for this study was a quantitative, cross-sectional. I chose a quantitative methodology over a qualitative methodology because I wished to examine the association between variables of interest. I chose a cross-sectional because of its wider applicability, its ability to provide numerical descriptions of trends, and its ability to measure levels of occurrence of an event (Creswell, 2009). The dependent variable in this study was the incidence of CAUTI, and the independent variables were gender, age, and hospital types (government-owned, private nonprofit, and private for-profit). The targeted population was patients with CAUTI during their hospital stay. Data analysis was performed on secondary data obtained from the HCUP.

I aimed to explore the role of gender, age, and hospital types namely government-owned, private nonprofit, and private for-profit in the incidence of CAUTI in New York and North Carolina between 2012 and 2014. The quantitative study was nonexperimental with variables occurring naturally in a setting, and there was no manipulation or random selection of the samples used in the study. Comparative research designs were used to obtain information about the current status of the phenomenon and to describe concerns regarding CAUTI incidence between states. I incorporated a cross-sectional approach, meaning that data were collected at a single point in time rather than across time.

Study Population and Sample Size

The population of the study consisted of all individuals who received medical care in New York and North Carolina acute care hospitals and who had an indwelling urinary catheter from January 1st, 2012 to December 31st, 2014. Data were extracted from the HCUP. The HCUP comprises health care databases on inpatient hospital stays from participating states in the United States. Data on gender, age, and hospital types were also obtained. In North Carolina, there were patients with CAUTI in 123 hospitals in 2012, 122 hospitals in 2013, and 121 hospitals in 2014. In New York record shows there were patients with CAUTI in 176 hospitals in 2012, 177 hospitals in 2013, and 174 hospitals in 2014 as contained in the HCUP database.

To determine an appropriate sample size to decrease the likelihoods of making a Type II error, a power analysis was conducted using the G*Power statistical program. Power is the possibility of correctly rejecting the null hypothesis by making sure that the projected sample size does not differ statistically from the original population and the study group of interest (Suresh & Chandrashekara, 2012). Type II errors typically occur when the sample size is too small. Falsely accepting the null or failing to correctly reject the null hypothesis will lead to a Type II error. The sample size was calculated using the effect size (0.15), a probability level of statistical significance (0.05), and the statistical power (0.80; Erdfelder, Faul, & Buchner, 2005). The minimum calculated sample size was 551. In this study, the sample size was larger than 551. The finding is supported by good power.

Data sampling did not occur because CAUTI incidence are reported by the state with an inclusion criterion for diagnosis for CAUTI including precatheter insertion for more than 2 days. The HCUP database has individual-level data with no personal identifiers.

Data Collection

Having received approval from the Walden University Institutional Review Board (Approval Number 08-22-16-0398249), I requested data from the HCUP. I then cleaned the collected data, extracting the number of CAUTI patients in acute care hospitals in New York and North Carolina between 2012 and 2014 using SPSS. The extracted data obtained from the HCUP database contained information on a number of CAUTI incidents based on gender and age. Information on CAUTI incidence and hospital types categorized as government-owned, private not-for-profit, and private for-profit in New York and North Carolina between 2012 and 2014 were extracted from the HCUP website.

Data Analysis Plan

Secondary data were accessed from the HCUP. Data cleaning and screening procedures were performed by checking for missing values and deciding what to do if there were missing values, checking for outliers and normality, and deciding how to deal with outliers and non-normality. Using SPSS software, simple logistic regression and multivariable logistic regression analyses were employed to answer the research questions outlined for this study.

Logistic regression is a statistical method that can be used to analyze a dataset of a categorical and dichotomous dependent variable in which the independent variable can be a combination continuous and categorical (Hosmer, 2013). Logistic regression is used to describe a dataset and explain the relationship that exists between one dependent variable and one or more independent variables. In epidemiologic studies, the logistic regression model has been identified as a tool that enables multiple explanatory variables to be analyzed simultaneously, while reducing the effect of confounding factors (Sperandei, 2014).

The assumptions associated with logistic regression are linearity of independent variables and log odds, independence of errors, and little or no multicollinearity meaning that independent variables should be independent of each other. Logistic regression assumes that P(Y=1), which is the probability of the event occurring. To ensure linearity, the independent variables were appropriately categorized, and the dependent variable was coded accordingly. The Durbin-Watson Statistic testing was used to test for independence of errors.

For the model to be fitted correctly, a stepwise method was used to estimate the logistic regression because it selects appropriate independent variables from the model based on predefined statistical criteria that are influenced by the unique characteristics of the sample being analyzed (Tabachnick & Fidell, 2007). I used the logistic regression test to measure the relationship between the categorical dependent variable, CAUTI incidence, and the independent variable gender in Research Question 1, I used the logistic regression test to measure the relationship between the categorical dependent variable, CAUTI rate, and independent variable, age, in Research Question 2.

In this study, the variables met the logistic regression assumptions. The dependent variable CAUTI was a stochastic event with a *yes* and *no* consequence while the independent variable was categorized into age groups 0-17, 18-44, 45-64, 65-84, and 85 years and above and were appropriately dummy coded. The output from the logistic regression includes an odd ratio analysis that is interpreted to explain the relationships and strengths among the variables of interest.

Hierarchical multivariable regression is a statistical tool that is used to show if variables of interest explain a statistically significant amount of variance in the dependent variable after accounting for all other variables. The hierarchical multivariable regression is a model for comparison rather than a statistical method. Regression models are created by adding variables to a previous model at each step. The goal is to determine if newly added variables show a significant improvement in R^2 (the proportion of explained variance in dependent variable by the model).

Research Questions and Hypotheses

I tested three hypotheses in the attempt to answer three research questions:

RQ 1: Is there any significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014?

$H_0 1$: There is no significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a1: There is a significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: gender
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 2: Is there any significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014?

H_02: There is no significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a2: There is a significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: Age
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 3: Is there any significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014?

H_03: There is no significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a3: There is a significant relationship between hospital types categorized as government-owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number CAUTI
- Independent variable: Hospital types (government-owned, private nonprofit, and private for profit).
- Analysis: analysis of CAUTI occurrences by hospital type reported in New York and North Carolina between 2012 and 2014.

Threats to Validity and Reliability

Reliability refers to the interitem consistency of a latent construct. Scholars use reliability analysis to study the component and features of the measuring tool (Tabachnic & Fidell, 2007). Concern for reliability is not applicable in this study given the characteristics of the data because the data could not be obtained from single-value ratio data.

Validity refers to the assumption that the CAUTI value obtained measures the catheter infection rate of a population. The validity of the data was assumed given that the data had been screened, processed, and analyzed under the directive of the CDC. External validity addresses the extent to which the results of this study can be generalized to other contexts including situational interaction effects of selection and specificity of variables. Secondary data were used for this study, which could introduce threats to potential external validity.

Ethical Procedures

I analyzed secondary data with no personal identifiers, no human participants, and no ethical concerns related to data collection. To have access to HCUP data, I completed and signed the HCUP Data Use Agreement (DUA) Training Course before receiving data. A web-based training course summarized essential points in the DUA. The online course emphasized the importance of data protection and reducing the risk of inadvertent violations, and described my responsibilities, as a researcher, when using HCUP data. The HCUP DUA were maintained; data were stored in a protected medium, will be held for 5 years after the study the conclusion of the study, and will be destroyed afterwards. The findings from this study will be shared with the dissertation committee and review boards.

Summary

In Chapter 3, I described the research design and methodology including the population being investigated, the sampling methods, and the data collection processes and analysis. The research questions were restated, and I identified the threats to validity including minimizing the threats and increasing reliability and validity of the study. The description of the data analysis is presented in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this study was to explore the association between CAUTI incidence and gender, age, and hospital types in New York and North Carolina over a 3-year period. I reviewed and analyzed data from the HCUP database using simple logistic regression and hierarchical multivariable logistic regression analysis on archival data from HCUP.

This chapter provides the characteristics of the target population; hypotheses; logistic regression and hierarchical multivariable logistic regression analyses; assumptions; and analysis of the literature findings on the difference in the incidence of CAUTI by hospital types categorized as government-owned, private not-for-profit, and private for-profit in New York and North Carolina between 2012 and 2014. A discussion section in this chapter includes data collection, data management processes, descriptive statistics of the variables of interest, statistical analyses using tables for each research question, and a summary of the results. The incidence rate was used to measure the frequency of occurrence of new cases of infection within a defined population during a specified time frame. The incidence rate was calculated as shown below.

Equation 1

$$\text{Incidence rate} = \frac{\text{\# of Infections}}{\text{Population at Risk}} \times k\ \text{(constant)}$$

= number of infections cases identified by surveillance activities

The population at risk = Number of patients on the patient care unit during exposed to catheter insertion during a defined time frame in a defined population.

k (constant) = represents a standard population and time period for interpretation of the rate. The assigned value is 100 and may be interpreted as a percentage.

Below are the three research questions and hypotheses for this study:

RQ 1: Is there any significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014?

$H_0 1$: There is no significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

$H_a 1$: There is a significant relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: gender
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 2: Is there any significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014?

$H_0$2: There is no significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a2: There is a significant relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number of CAUTI
- Independent variable: Age
- Statistical analysis: simple logistic regression and multivariable logistic regression analysis.

RQ 3: Is there any significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014?

$H_0$3: There is no significant relationship between hospital types categorized as government- owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

H_a3: There is a significant relationship between hospital types categorized as government-owned, private not-for-profit, and private for-profit, and CAUTI incidence in New York and North Carolina between 2012 and 2014.

- Dependent variable: number CAUTI
- Independent variable: Hospital types (government-owned, private nonprofit, and private for profit).
- Analysis: analysis of CAUTI occurrences by hospital type reported in New York and North Carolina between 2012 and 2014.

The frequency distribution and descriptive statistics of the number of CAUTI for Gender in North Carolina and New York are presented in Table 5 and 6, and the frequency distribution of CAUTI by age group in New York and North Carolina from 2012 to 2014 are presented in Table 7 and 8. The result of the findings of CAUTI in the different hospital types in North Carolina and New York for the year 2012, 2013, and 2014 is shown in Tables 9.

Descriptive Data Analysis

The findings begin with an overview of descriptive statistics. The statistical data relating the population of interest in this study are as follows.

Gender Variable

I found that the CAUTI incidence rate among males in New York was 17.2, 19.4%, 23%, in the years 2012, 2013, and 2014 respectively. The CAUTI incidence rate among females in New York was 7.2%, 9.0%, and 11% in the years 2012, 2013, and 2014 respectively.

Table 5

Distribution of CAUTI by Gender in New York from 2012 to 2014

Gender	2012		2013		2014	
	# of CAUTI	Incidence rate (%)	# of CAUTI	Incidence Rate (%)	# of CAUTI	Incidence rate (%)
Total	4,157	11.7	4,312	14	5,126	17.1
Male	2,728	17.2	2,892	19.4	3,457	23
Female	1,429	7.2	1,420	9.0	1,669	11

I found that the CAUTI incidence rate among males in North Carolina was 36.1%, 44.3%, and 37.1% in the years 2012, 2013, and 2014 respectively. The CAUTI incidence rate among females in North Carolina was 31.5 %, 36.5%, and 17.8% in the years 2012, 2013, and 2014 respectively. Table 7 shows the CAUTI incidence rate among age group in New York from 2012 to 2014.

Table 6

Distribution of CAUTI by Gender in North Carolina from 2012 to 2014

Gender	2012		2013		2014	
	No. of CAUTI	Incidence rate (%)	No. of CAUTI	Incidence rate (%)	No. of CAUTI	Incidence rate (%)
Total	3,089	36.1	3,330	40.9	3,859	26.2
Male	1,824	40.1	2,017	44.3	2,376	37.1
Female	1,265	31.5	1,313	36.5	1,483	17.8

Age Groups

In 2012 in New York, 35,609 patients were at risk for CAUTI due to the indwelling urethral catheter. Specifically, 3.1% of age group 0-17, 3.3% of the age group 18-44, 12.9% of the age group 45-64, 14.9% of the age group 65-84, and 14.1% of the age group 85 and above were diagnosed with CAUTI.

In 2013 in New York, 30,788 patients were at risk for CAUTI due to the indwelling urethral catheter. Specifically, 3.6% of the age group 0-17, 5.4% of the age group 18-44, 14.5% of the age group 45-64, 16.3% of the age group 65-84, and 16.7% of the age group 85 and above were diagnosed with CAUTI.

In 2014 in New York, 29,997 patients were at risk for CAUTI due to indwelling urethral catheter. Specifically, 6.9% of the age group 0-17, 6.1% of the age group 18-44, 17.1% of the age group 45-64, 19.4% of the age group 65-84, and 22.4% of the age group 85 and above were diagnosed with CAUTI. Table 8 shows the distribution of CAUTI by age group in North Carolina from 2012 to 2014.

Table 7

Frequency Distribution of CAUTI by Age Group in New York from 2012 to 2014

Age Group	2012			2013			2014		
	# at Risk	# of CAUTI	Incidence Rate	# at Risk	# of CAUTI	Incidence Rate	# at Risk	# of CAUTI	Incidence Rate
Age 0-17	486	15	3.1	421	15	3.6	393	27	6.9
Age 18-44	7,547	246	3.3	5,101	273	5.4	5,224	317	6.1
Age 45-64	7,123	915	12.9	6,502	945	14.5	6,197	1,058	17.1
Age 65-84	13,024	1,936	14.9	12,086	1,967	16.3	11,682	2,267	19.4
Age 85+	7,429	1,045	14.1	6,678	1,112	16.7	6,501	1,457	22.4
Total	35,609	4,157	11.7	30,788	4,312	14.0	29,997	5,126	17.1

In 2012 in North Carolina, 8,556 patients were at risk for CAUTI due to the indwelling urethral catheter. Specifically, 7.7% of the age group 0-17, 38.8% of the age group 18-44, 35.3% of the age group 45-64, 35.1% of the age group 65-84, and 36.3% of the age group 85 and above were diagnosed with CAUTI.

In 2013 in North Carolina, 8,151 patients were at risk for CAUTI due to indwelling urethral catheter. Specifically, 15.6% of the age group 0-17, 41.4% of the age group 18-44, 42.7% of the age group 45-64, 39.9% of the age group 65-84, and 41.9% of the age group 85 and above were diagnosed with CAUTI.

In 2014 in North Carolina, 14,733 patients were at risk for CAUTI due to the indwelling urethral catheter. Specifically, 7.7% of the age group 0-17, 9.1% of the age group 18-44, 32.9% of the age group 45-64, 32.4% of the age group 65-84, and 36.5% of the age group 85 and above were diagnosed with CAUTI.

Table 8

Frequency Distribution of CAUTI by Age Group in North Carolina from 2012 to 2014

Age Group	2012			2013			2014		
	# at Risk	#. of CAUTI	Inciden ce Rate	# at Risk	# of CAUTI	Inciden ce Rate	# at Risk	# of CAUTI	Inciden ce Rate
Age 0-17	91	7	7.7	77	12	15.6	246	19	7.7
Age 18-44	901	350	38.8	801	332	41.4	4062	368	9.1
Age 45-64	2077	790	35.3	2000	854	42.7	3116	1025	32.9
Age 65-84	3937	1380	35.1	3822	1524	39.9	5429	1761	32.4
Age 85+	1550	562	36.3	1451	608	41.9	1880	686	36.5
Total	8556	3089	36.1	8151	3330	40,8	14733	3859	26.1

Hospital Types

Secondary data collected from HCUP database do not contain information on the hospital types. The information on hospital types was obtained from the HCUP web site. Data included findings of the incidence of CAUTI by hospital types categorized as government-owned, private not-for-profit, and private for-profit in New York and North Carolina between 2012 and 2014.

Table 9

Number of Hospitals by Ownership Type and CAUTI Occurrences in New York from 2012 to 2014

Year	Hospital Type	Number of Hospitals	Number of CAUTI	Hospital Type Ratio
2012	Government owned	26	251	9.7
	Private, not-for-profit	152	2,171	14.3
	Private, for-profit	0	0	0
2013	Government owned	25	281	11.2
	Private not-for-profit	152	2,463	16.2
	Private, for-profit	0	0	0
2014	Government owned	24	335	14.0
	Private, not-for-profit	150	2,980	19.9
	Private, for-profit	0	0	0

Note. Number of Hospitals by Ownership Type and CAUTI Occurrences in New York. Adapted from https://hcupnet-archive.ahrq.gov

In New York, I found that in 2012, there were 9.7 CAUTI infections per government-owned hospital and 14.3 CAUTI infections per private, not-for-profit owned hospital. In 2013, there were 11.2 CAUTI infections per government-owned hospital and 16.2 CAUTI infections per private, not-for-profit owned hospital. In 2014, there were 14.0 CAUTI infections per government-owned hospital and 19.9 CAUTI infections per private, not-for-profit owned hospital.

Table 10

Number of Hospitals by Ownership Type and CAUTI occurrences in North Carolina from 2012 to 2014

Year	Hospital Type	Number of Hospitals	Number of CAUTI	Hospital Type Ratio
2012	Government owned	35	622	17.8
	Private, not-for-profit	72	1066	14.8
	Private, for-profit	16	68	4.2
2013	Government owned	33	620	18.8
	Private, not-for-profit	72	1227	17.0
	Private, for-profit	17	90	5.3
2014	Government owned	33	779	23.6
	Private, not-for-profit	68	1473	21.7
	Private, for-profit	20	87	4.4

Note. Number of Hospitals by Ownership Type and CAUTI Occurrences in North Carolina. Adapted from https://hcupnet-archive.ahrq.gov

In New York, I found that in 2012, there were 17.8 CAUTI infections per government-owned hospital; 14.8 CAUTI infections per private, not-for-profit owned hospital; and 4.2 CAUTI infections per private for owned hospital. In 2013, there were 18.8 CAUTI infections per government-owned hospital; 17.0 CAUTI infections per private, not-for-profit owned hospital; and 5.3 CAUTI infections per private for owned hospital. In 2014, there were 23.6 CAUTI infections per government-owned hospital; 21.7 CAUTI infections per private, not-for-profit owned hospital; and 4.4 CAUTI infections per private for owned hospital.

Hypothesis Testing

Simple Logistic Regression Analysis

A logistic regression was performed to determine the effects of gender on the likelihood of a patient diagnosed with CAUTI from the insertion of an indwelling urinary catheter in New York and North Carolina in 2012, 2013, and 2014. In New York 2012, the logistic regression model was statistically significant, $X^2(1) = 852.590$, $p < .0005$, indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis that there is no significant relationship between gender and CAUTI incidence in New York ion 2012 is rejected; there is significant relationship between gender and CAUTI incidence. The Negelkerke R^2 of .048 indicated a very weak relationship and the model indicates that the odd of having CAUTI is 2.672 times greater for males as oppose to females in New York in 2012.

In New York 2013, the logistic regression model was statistically significant, $X^2(1) = 702.125$, $p < .0005$, indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in New York in 2013. The Negelkerke R^2 of .023 indicated a very weak relationship, and the model indicates that the odd of having CAUTI is 0.410 times greater for males as oppose to females in New York in 2013.

In New York 2014, the logistic regression model was statistically significant, $X^2(1) = 832.621$, $p < .0005$, indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis is rejected; there is a significant relationship between gender and CAUTI incidence in New York in 2014. The Negelkerke R^2 of .046 indicated a very weak relationship. The model indicated that the odd of having CAUTI is 2.482 times greater for males as oppose to female in New York in 2014.

In North Carolina 2012, the logistic regression model was statistically significant, $X^2(1) = 68.483$, Sig = .000 ($p < .0005$), indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis is rejected, that there is significant relationship between gender and CAUTI incidence in North Carolina in 2012. The Negelkerke R^2 of .011 indicated a very weak relationship. The model indicated that the odd of having CAUTI is 1.455 times greater for males as oppose to female in North Carolina in 2012.

In North Carolina 2013, the logistic regression model was statistically significant, $X^2(1) = 51.943$, $p < .0005$, indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in North Carolina in 2013. The Negelkerke R^2 of .009 indicated a very weak relationship. The model indicated that the odd of having CAUTI is 1.389 times greater for males as oppose to female in North Carolina in 2013.

In North Carolina 2014, the logistic regression model was statically significant, $X^2(1) = 696.139$, $p < .0005$, indicating that there is a statistically significant association between gender and CAUTI. The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in North Carolina in 2014. The

Negelkerke R^2 of .068 indicated a very weak relationship. The model indicated that the odd of having CAUTI is 2.727 times greater for males as oppose to female in North Carolina in 2014.

Table 11

Logistic Regression Test of Relationship Between CAUTI and Gender in New York and North Carolina Between 2012 and 2014

State	Year	Gender	Total Count	CAUTI Count (%)	df	X^2	NR^2	Sig	Odd of CAUTI
New York	2012	Male	15835	2728 (17.2%)	1	853.2	.048	.000	2.672
		Female	19776	1429 (7.2 %)					
	2013	Male	14933	2892 (19.4%)	1	692.2	.023	.000	.410
		Female	15857	1420 (9.0%)					
	2014	Male	14772	3547 (24.0%)	1	819.2	.046	.000	2.482
		Female	15227	1669 (11.0%)					
North Carolina	2012	Male	4545	1824 (40.1%)	1	68.483	.011	.000	1.455
		Female	4011	1265 (31.5%)					
	2013	Male	4549	2017 (44.3%)	1	51.8	.009	.000	1.389
		Female	3602	1313 (36.5%)					
	2014	Male	6406	2376 (37.1%)	1	698.4	.068	.000	2.727
		Female	8319	1483 (17.8%)					

Note: Where df = the degrees of freedom, X^2 = Chi square, Sig. = Significance level. NR^2= Nagelkerke R Square

Multivariable Logistic Regression Analysis

Hierarchical multivariable regression analysis was conducted to determine the effect of gender on CAUTI incidence in New York in 2012, 2013, and 2014. Initial analyses were performed to ensure there was no violation of the assumption of normality, linearity, multicollinearity and homoscedasticity. In New York 2012, after controlling for age of patient, this model was statistically significant F (1, 35607) = 635.855, $p < .001$ and explained 1.8% of variance in CAUTI occurrence. After entry of gender of patient at Step 2 the total variance explained by the model as a whole was 3.6% (F (2, 35606) = 655.853, $p < .001$). The introduction of gender explained additional 1.8% of variance in

CAUTI incidence after controlling for age. In the adjusted model both gender and age were statistically significant, however, gender recorded a higher Beta Value (β = .136, p < .001) than age (β = -.109, *p* < .001. The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence, even after controlling for age in New York in 2012.

In New York 2013, after controlling for age of patient, this model was statistically significant *F* (1, 30786) = 46,719, *p* < .001 and explained 1.3% of variance in CAUTI occurrence. After entry of gender of patient at Step 2 the total variance explained by the model as a whole was 3.1% (*F* (2, 3307) = 58.228, *p* < .001). The introduction of gender explained additional 1.9% of variance in CAUTI incidence after controlling for age. In the adjusted model both gender and age were statistically significant, however, gender recorded a higher Beta Value (β = .138, *p* < .001) than age (β = -.095, *p* < .001). The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in New York 2012 after controlling for age.

In New York 2014, after controlling for age of patient this model was statistically significant *F* (1, 29995) = 630.617, *p* < .001 and explained 2.1% of variance in CAUTI occurrence. After entry of gender of patient at Step 2 the total variance explained by the model as a whole was 4.1% (*F* (2, 29994) = 636.135, *p* < .001). The introduction of gender explained additional 2.0% of variance in CAUTI incidence after controlling for age. In the adjusted model both gender and age were statistically significant, however, gender recorded a higher Beta Value (β = .145, *p* < .001) than age (β = -.118, *p* < .001).

The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in New York 2012 after controlling for age.

Table 12

Hierarchical Multivariable Regression Analysis Between CAUTI and Gender in New York Between 2012 and 2014

Year		*R*	*R^2*	*R^2 Change*	*B*	*β*	df/Res	*F*	*Sig.*
	Step 1	.132	.018	.018					
2012	Age				-.002	-.132	1(35607)	635.855	.651
	Step 2	.188	.036	.018					
	Age				.000	-.109	2(35606)	655.853	.479
	Gender				.086	.136			.000
2013	Step 1	.122	.013	.013					
	Age				-.002	-.112	1(30787)	392.848	.158
	Step 2	.177	.031	.019					
	Age				-.002	-.095	2(30785)	499.122	.133
	Gender				.096	.138			.000
2014	Step 1	.143	.021	.021					
	Age				-.003	-.143	1(29995)	630.617	.000
	Step2	.202	.041	.020					
	Age				-.008	-.118	2(29994)	640.053	.000
	Gender				.108	.145			.000

R = Unstandardized coefficient

R2 = amount of variance explained by IVs

R2 Change = additional variance in dependent variable

β = Standardized Coefficient Beta

B = Unstandardized Coefficient Beta

F = *F* test

Sig. = Significance level

df/Res = Degree of freedom/Residual from ANOVA

Hierarchical multivariable regression analysis was conducted between CAUTI and Gender (controlling Age) to determine the effect of gender on CAUTI incidence in North Carolina in 2012, 2013 and 2014. Analyses were performed to ensure there was no violation of the assumption of normality, linearity, multicollinearity and homoscedasticity.

In 2012, Age (variable to be controlled) was entered into Step 1 and the model was not statistically significant F (1, 8554) = .205. Sig. = .651 ($p > .05$) and explained less than 0.1% of variance in CAUTI occurrence. After entry of gender of patient at Step 2, the model was statistically significant F (2, 8553) = 34.62. Sig = .000 ($p < .001$). The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in North Carolina 2012 after controlling for age. The total variance explained by the model as a whole was 0.8%, the introduction of gender explained additional 0.8% of variance in CAUTI incidence. In the adjusted model, only gender was statistically significant and recorded a higher Beta Value ($\beta = .09$, $p < .001$) than age ($\beta = .008$, $p > .05$).

In 2013, Age (variable to be controlled) was entered into Step 1 and the model was not statistically significant F (1, 8149) = 1.997. Sig. = .158 ($p > .05$) and explained less than 0.1% of variance in CAUTI occurrence. After entry of gender of patient at Step 2, however, the model was statistically significant F (2, 8148) = 27.169. Sig = .000 (p <

.001). The null hypothesis is rejected; there is significant relationship between gender and CAUTI incidence in North Carolina 2012 after controlling for age. The introduction of gender explained additional 0.6% of variance in CAUTI incidence after controlling for age, and the total variance explained by the model as a whole was 0.7%. In the adjusted model, only gender was statistically significant and recorded a higher Beta Value (β = .08, $p < .001$) than age (β = -.007, $p > .05$).

In 2014, Age (variable to be controlled) was entered into Step 1 and the model was statistically significant F (1, 14723) = 890.388. Sig. = .000 ($p < .001$) and explained 5.7% of variance in CAUTI occurrence. After entry of gender of patient at Step 2, the model was statistically significant F (2, 14722) = 650.430. Sig. = .000, ($p < .001$). The null hypothesis is rejected; there is a significant relationship between gender and CAUTI incidence in North Carolina 2012 after controlling for age. The introduction of gender explained additional 2.4% of variance in CAUTI incidence after controlling for age. The total variance explained by the model as a whole was 8.1%. In the adjusted model both IV, gender and age were statistically significant, however, gender recorded a higher Beta Value (β = .162, $p < .001$) than age (β = -.192, $p < .001$).

Table 13

Hierarchical Multivariable Regression Analysis Between CAUTI and Gender in North Carolina Between 2012 and 2014

Year		*R*	R^2	R^2 *Change*	*B*	*β*	df/Res	*F*	*Sig.*
	Step 1	.005	.000						
2012	Age				.000	-.005	1(8554)	.205	.651
	Step 2	.090	.008	.008					
	Age				.000	-.008	2(8553)	34.620	.479
	Gender				.086	.090			.000
2013	Step 1	.016	.000	.000					
	Age				.000	-.006	1(8149)	1.997	.158
	Step 2	.081	.007	.006					
	Age				.000	-.007	2(8148)	27.169	.133
	Gender				.079	.080			.000
2014	Step 1	.239	.057						
	Age				-.005	-.289	1(14723)	890.388	.000
	Step2	.285	.081	.024					
	Age				-.004	-.192	2(14722)	650.430	.000
	Gender				144	.162			.000

R = Unstandardized coefficient

R2 = amount of variance explained by IVs

R2 Change = additional variance in dependent variable

β = Standardized Coefficient Beta

B = Unstandardized Coefficient Beta

F = F test

Sig. = Significance

Df/Res = Degree of freedom/Residual from ANOVA

Simple Logistic Regression Analysis

A simple logistic regression analysis was performed to determine the effect of patients' Age Groups, 0-17, 18-44, 45-64, 65-84, and 85+ on the likelihood of a patient being diagnosed with CAUTI from the insertion of the indwelling urinary catheter in New York in 2012, 2013, and 2014. In New York 2012, a test of the full model against a constant only model was statistically significant, $X^2(4) = 916.453$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .049 indicated a very weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in New York in 2012 is rejected.

The individual predictors (categorized ages) were examined further and the result indicated that all but Age Group 18-44 were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the result indicated that the odds of developing CAUTI is higher in all other age groups compared to Age 0-17. The odds of developing CAUTI is the highest with age group 65-84 in New York in 2012 followed by Age 85+ then Age Group 45-64 and Age Group 18-44 years.

The odds of Age Group 18-44 developing CAUTI is 1.058 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 4.628 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 5.483 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 5.140 times higher than Age Group 0-17years New York 2012.

In New York 2013, a test of the full model against a constant only model was statistically significant, $X^2(4) = 541.023$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .031 indicated a very weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in New York in 2013 is rejected.

The individual predictors (categorized ages) were examined further and the result indicated that all but Age Group 18-44 ($p = .111$) were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the result indicated that the odd of developing CAUTI is higher in all other age groups compared to Age 0-17. The odds of developing CAUTI is the highest with Age Group 85+ in New York in 2013 followed by Age 65-84 then Age Group 45-64 and Age Group 18-44 years.

The odds of Age Group 18-44 developing CAUTI is 1.538 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 4.626 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 5.287 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 5.434 times higher than Age Group 0-17years New York 2013.

In New York 2014, a test of the full model against a constant only model was statistically significant, $X^2(4) = 768.263$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .042 indicated a very weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in New York in 2014 is rejected.

The individual predictors (categorized ages) were examined further and the result indicates that all but Age Group 18-44 (p = .540) were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the results indicated that the odds of developing CAUTI is higher in all other age groups compared to Age 0-17. The odd of developing CAUTI is the highest with Age Group 85+ in New York in 2014 followed by Age 65-84 then Age Group 45-64 and Age Group 18-44 years.

The odds of Age Group 18-44 developing CAUTI is .880 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 2.806 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 3.282 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 3.937 times higher than Age Group 0-17years in New York 2014.

Table 14

Logistic Regression Analysis to Test the Relationship Between Age and CAUTI in New York Between 2012 and 2014

Year	Age Group	CAUTI # (%)	*df*	X^2	NR^2	Sig	Odd Ratio (Exp(B))
2012			4	916.453	.049	.000	
Step 1[a]	18-44	246(5.9%)	1			.835	1.058
	45-64	915 (22.0%)	1			.000	4.628
	65-84	1936 (46.6%)	1			.000	5.483
	85+	1045 (25.1%)	1			.000	5.140
	Constant		1			.000	0.032
2013			4	541.023	.031	.000	
Step 1[a]	18-44	273 (6.4%)	1			.111	1.538
	45-64	945 (21.9%)	1			.000	4.626
	65-84	1967 (45.6%)	1			.000	5.287
	85+	1112 (25.8%)	1			.000	5.434
	Constant		1			.000	0.37
2014			4	768.263	.042	.000	
Step 1[a]	18-44	317 (6.2%)	1			.540	.880
	45-64	1058 (20.7%)	1			.000	2.806
	65-84	2267 (44.2%)	1			.000	3.282
	85+	1457 (28.4%)	1			.000	3.937
	Constant		1			.000	0.073

a. Variable(s) entered on step 1[a]: Age 18 - 44, Age 45 - 64, Age 65 - 84, Age 85+.

A simple logistic regression analysis was performed to determine the effect of patients' Age Groups, 0-17, 18-44, 45-64, 65-84, and 85+ on the likelihood of a patient being diagnosed with CAUTI from insertion of an indwelling urinary catheter in North Carolina in 2012, 2013, and 2014. In North Carolina 2012, a test of the full model against a constant only model was statistically significant, $X^2(4) = 48.308$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .008 indicated a very weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in North Carolina in 2012 is rejected.

The individual predictors (categorized ages) were examined further, and the result indicated that all the age groups were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the results indicated that the odds of developing CAUTI is higher in all other age groups compared to the Age 0-17. The odds of developing CAUTI is the highest with Age Group 18-44 in North Carolina in 2012 followed by Age 45-64 then Age Group 85+ and Age Group 65-84 years.

The odds of Age Group 18-44 developing CAUTI is 7.623 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 7.366 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 6.476 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 6.826 times higher than Age Group 0-17years in 2012 in North Carolina.

In North Carolina 2013, a test of the full model against a constant only model was statistically significant, $X^2(4) = 28.222$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .005 indicated a very weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in North Carolina in 2013 is rejected.

The individual predictors (categorized ages) were examined further and the result indicated that all the age groups were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the result indicated that the odd of developing CAUTI is higher in all other age groups compared to Age 0-17. The odds of developing CAUTI is the highest with Age Group 45-64 in North Carolina in 2013 followed by Age 85+ then Age Group 18-44 and Age Group 65-84 years.

The odds of Age Group 18-44 developing CAUTI is 3.834 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 4.037 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 3.592 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 3.907 times higher than Age Group 0-17 in North Carolina in 2013.

In North Carolina in 2014, a test of the full model against a constant only model was statistically significant, $X^2(4) = 1085.442$, $p < .0001$, with $df = 4$, indicating that there is a statistically significant association between the age groups and CAUTI although the Nagelkerke's R^2 of .104 indicated a weak relationship. The null hypothesis that there is no significant relationship between age and CAUTI in North Carolina in 2014 is rejected.

The individual predictors (categorized ages) were examined further and the result indicated that all but Age Group 18-44 were significant predictors in the model. Using Age Group 0-17 as the reference category (constant), the results indicated that the odd of developing CAUTI is higher in all other age groups compared to Age 0-17. The odd of developing CAUTI is the highest with Age Group 85+ in North Carolina in 2014 followed by Age 45-64 then Age Group 65-84 and Age Group 18-44 years.

The odds of Age Group 18-44 developing CAUTI is 1.190 times higher than Age Group 0-17, the odds of Age Group 45-64 developing CAUTI is 5.857 times higher than Age Group 0-17, the odds of Age Group 65-84 developing CAUTI is 5.736 times higher than Age Group 0-17, and the odds of Age Group 85years and above developing CAUTI is 6.864 times higher than Age Group 0-17years in North Carolina in 2014.

Table 15

Logistic Regression Analysis to Test the Relationship Between Age and CAUTI in North Carolina Between 2012 and 2014

Year	Age Group	CAUTI # (%)	*df*	X^2	NR^2	Sig	(Exp(B))
2012			4	48.308	.008	.000	
Step 1[a]	18-44	350 (11.3%)	1			.000	7.623
	45-64	790 (25.6%)	1			.000	7.366
	65-84	1390 (44.7%)	1			.000	6.476
	85+	562 18.2%)	1			.000	6.826
	Constant		1			.000	.083
2013			4	28.222	.005	.000	
Step 1[a]	18-44	332 (9.9%)	1			.000	3.834
	45-64	854 (25.6%)	1			.000	4.037
	65-84	1524 (45.8%)	1			.000	3.592
	85+	608 (18.3%)	1			.000	3.907
	Constant		1			.000	.185
2014			4	1085.44	.104	.000	
Step 1[a]	18-44	368 (9.5%)	1			.477	1.190
	45-64	1025 (26.6%)	1			.000	5.857
	65-84	1761 (45.6%)	1			.000	5.736
	85+	686 (17.8%)	1			.000	6.864
	Constant		1			.000	0.084

Variable(s) entered on step 1[a]: Age 18 - 44, Age 45 - 64, Age 65 - 84, Age 85+.

Multivariable Logistic Regression Analysis

Hierarchical multivariable regression analysis was performed to determine the effect of age on CAUTI occurrence in New York in 2012, 2013, and 2014. Initial analyses were performed to ensure there was no violation of the assumption of normality, linearity, multicollinearity, and homoscedasticity.

Table 16

Hierarchical Multivariable Regression Analysis to Test the Relationship Between Age and CAUTI in New York Between 2012 and 2014

Year		*R*	R^2	R^2 *Change*	*B*	*β*	*df/Res*	*F*	*Sig.*
	Step 1	.155	.024						
2012	Gender				.100	.155	1(35607)	873.848	.000
	Step 2	.188	.036	.012					
	Gender				.088	.136	2(35606)	655.853	.000
	Age				-.002	-.109			.000
2013	Step 1	.150	.022						
	Gender				.104	.150	1(30786)	708.038	.000
	Step 2	.177	.031	.009					
	Gender				.096	.138	2(30785)	499.122	.000
	Age				-.002	-.095			. 000
2014	Step 1	.165	.027						
	Gender				.124	.156	1(29995)	842.117	.000
	Step2	.202	.041	.014					
	Gender				.109	.145	2(29996)	640.053	.000
	Age				-.002	-.118			.000

In 2012, after controlling for gender, the model was statistically significant F (1, 35607) = 873.848, $p < .001$ and explained 2.4% of the variance in CAUTI occurrence in New York in 2012. After entry of age of the patient at Step 2, the model was significant and the null hypothesis is rejected. There is a significant relationship between age and CAUTI incidence in New York 2012 after controlling for gender. The total variance explained by the model as a whole was 3.6% (F (2, 35606) = 655.853, $p < .001$). The introduction of age explained additional 1.2% of the variance in CAUTI occurrence after controlling for gender. In the adjusted model both gender and age were statistically significant, however, age recorded a lower Beta value (β = -.109, $p < .001$) than gender (β = .136, $p < .001$)

In 2013, after controlling for gender, the model was statistically significant F (1, 30786) = 708.038, $p < .001$ and explained 2.2% of the variance in CAUTI occurrence in New York in 2013. After entry of age of patient at Step 2, the model was statistically significant (F (2, 30785) = 499.122, $p < .001$). There is a significant relationship between age and CAUTI incidence in New York 2013 after controlling for gender. The total variance explained by the model as a whole was 3.1%. The introduction of age explained additional 0.9% of the variance in CAUTI occurrence after controlling for gender. In the adjusted model both gender and age were statistically significant, however, age recorded a lower Beta value (β = -.085, $p < .001$) than gender (β = .138, $p < .001$)

In in 2014, after controlling for gender, the model was statistically significant F (1, 29995) = 842.117, $p < .001$ and explained 2.7% of the variance in CAUTI occurrence in New York in 2014. After entry of age of patient at Step 2, the model was statistically significant (F (2, 29994) = 640.053, $p < .001$). There is a significant relationship between age and CAUTI incidence in New York 2013 after controlling for gender. The total variance explained by the model as a whole was 4.1% The introduction of age explained additional 1.4% of the variance in CAUTI occurrence after controlling for gender. In the adjusted model both gender and age were statistically significant, however, age recorded a lower Beta value (β = -.118, $p < .001$) than gender (β = .145, $p < .001$) a lower Beta value (β = -.109, $p < .001$) than gender (β = .136, $p < .001$)

Hierarchical multivariable regression analysis was performed to determine the effect of age on CAUTI occurrence in North Carolina in 2012, 2013, and 2014.

Table 17

Hierarchical Multivariable Regression Analysis to Test the Relationship Between Age and CAUTI in North Carolina Between 2012 and 2014

Year		*R*	R^2	R^2 *Change*	*B*	*β*	df/Res	*F*	*Sig.*
	Step 1	.089	.008						
2012	Gender				.000	.086	1(8554)	68.743	.000
	Step 2	.090	.008	.000					
	Gender				.000	.086	2(8553)	34.620	.000
	Age				.086	.000			.479
2013	Step 1	.080	.006						
	Gender				.000	-.016	1(8149)	52.074	.000
	Step 2	.081	.007	.001					
	Gender				.000	-.017	2(8148)	27.169	.133
	Age				.079	.080			.000
2014	Step 1	.218	.047						
	Gender				.193	.218	1(14723)	733.064	.000
	Step2	.285	.081	.034					
	Gender				.114	.162	2(14722)	651.192	.000
	Age				-.004	-.192			.000

R = Unstandardized coefficient

R2 = amount of variance explained by IVs

R2 Change = additional variance in dependent variable

β = Standardized Coefficient Beta

B = Unstandardized Coefficient Beta

F = F test

Sig. = Significance

Df/Res = Degree of freedom/Residual from ANOVA

In North Carolina in 2012, after controlling for gender the model was statistically significant F (1, 8554) = 68.743, $p < .001$ and explained 0.8% of the variance in CAUTI occurrence. After entry of age of patient at Step 2, the total variance explained by the model remained the same 0.8% (F (2, 8553) = 34.620, $p < .001$). The introduction of age did not contribute to the variance in CAUTI occurrence after controlling for gender. In the adjusted model, only gender was statistically significant. The null hypothesis that there is no relationship between CAUTI and Age of patient after controlling for gender cannot be rejected. Gender recorded a higher Beta value (β = .090, p < .001) than age (β = -.008, p = .478.

In 2013, after controlling for gender the model was statistically significant F (1, 8149) = 52.072, $p < .001$ and explained 0.6% of the variance in CAUTI occurrence in North Carolina in 2013. After entry of age of the patient at Step 2 the total variance explained by the model as a whole was 0.7% (F (2, 8148) = 27.169, $p < .001$). The introduction of age explained additional 0.1% of the variance in CAUTI occurrence after controlling for gender. In the adjusted model, only ager was statistically significant and recorded a higher Beta value (β = .080, $p < .001$) than gender (β = -.017, $p = .133$).

In 2014, after controlling for gender, the model was statistically significant F (1, 14723) = 733.064, $p < .001$ and explained 4.7% of the variance in CAUTI occurrence in North Carolina. After entry of age of the patient at Step 2 the total variance explained by the model as a whole was 8.1% (F (2, 14722) = 651.192, $p < .001$). The introduction of age explained additional 3.4% of the variance in CAUTI occurrence after controlling for gender. In the adjusted model both gender and age were statistically significant, however, age recorded a lower Beta value (β = -.192, $p < .001$) than gender (β = .218 $p < .001$). The null hypothesis is not rejected. There is a significant relationship between age and CAUTI incidence in North Carolina in 2014 after controlling for gender.

Hospital Types

Statistical analysis could not be conducted to answer Research Question 3. There wereno data on hospital type categorized as government-owned, private not-for-profit, and private for-profit in New York and North Carolina between 2012 and 2014 in the secondary data obtained from HCUP. The hospital types information obtained from the HCUP website for the present study were not in a format that could be used to conduct statistical testing of the hypothesis for Research Question 3. The relationship between hospital types and CAUTI was evaluated using the findings from the HCUP website through a query to answer Research Question 3. The query provided the ratio of the number of CAUTI incidences per hospital type.

Summary

In this chapter, the results of the logistics regression and hierarchical multivariable regression analyses used to test the research questions and hypothesis generated for this study are presented. The simple logistics regression results show the relationship between gender and CAUTI prevalence in New York and North Carolina between 2012 and 2014 and the null hypotheses that there is no relationship between gender and CAUTI in New York and North Carolina between 2012 and 2014 were rejected.

Hierarchical multivariable logistic regression results showed statistical significant relationship between gender and CAUTI in New York and North Carolina between 2012 and 2014 after controlling for age. Hierarchical logistic regression results showed statistical significant relationship between age and CAUTI after controlling for gender in all but North Carolina 2012 where it is insignificant (p = .133). Research Question 3 could not be statistically answered; but, reported finding showed some trend in hospital types and CAUTI occurrences.

The interpretation of the findings, the limitations, and recommendations for future research are discussed in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to examine if there was a significant relationship between the dependent variable, CAUTI, and the independent variables of gender, age, and hospital types in New York and North Carolina over a 3-year period (2012, 2013, and 2014). Researchers have examined hospital types, gender, and age and CAUTI incidence (Garibaldi, Burke, Dickman, & Smith, 1974; Gillen, Isbell, Michaels, Lau, & Sawyer, 2015; Temiz et al., 2012). However, there is a gap in the literature regarding the influence of gender, age, and hospital types on the incidence CAUTI in New York and North Carolina between 2012 and 2014. The purpose of this study was to fill the gap in the literature by determining if there was a significant relationship between gender, age, and hospital types and CAUTI incidence in New York and North Carolina from 2012 to 2014.

I used a quantitative, cross-sectional research method to examine data from the HCUP. The health care data were collected through a federal-state-industry partnership and sponsored by the AHRQ. The independent variables included gender, age, and hospital types, while the dependent variable was the number of CAUTI.

Interpretation of the Findings

In New York, in descriptive analysis, I found that the CAUTI incidence rate among males in New York was 17.2, 19.4%, 23%, in years 2012, 2013, and 2014 respectively. The CAUTI incidence rate among females in New York was 7.2%, 9.0%, and 11% in the years 2012, 2013, and 2014 respectively. In the results of the simple logistic regression on gender and CAUTI incidence, I found a higher statistically significant relationship in CAUTI rate among males compared to the female population in 2012 (*P*-value 853.2), 2013 (*P*-value 692.2), and 2014 (*P*-value 819.2).

In North Carolina, in the descriptive analysis, I found a CAUTI incidence rate among the males in North Carolina at 36.1 %, 44.3%, and 37.1% in years 2012, 2013, and 2014 respectively. The CAUTI incidence rate among the females in North Carolina were 31.5%, 36.5%, and 17.8% in the years 2012, 2013, and 2014 respectively. I found a higher statistically significant relationship in CAUTI rates among males compared to the female population in 2012 (*P*-value 68.2), 2013 (*P*-value 51.8), and 2014 (*P*-value 698.4).

Hierarchical multivariable logistic regression analysis was conducted to test if there was a relationship between gender and CAUTI incidence in New York and North Carolina between 2012 and 2014 after controlling for age. I found that there was a significant relationship between gender and CAUTI incidence after controlling for age. The introduction of gender to the model in each case explained the additional percentage of variance in CAUTI incidence after controlling for age. The introduction of gender explained an additional 1.8% of variance in CAUTI incidence after controlling for age in New York in 2012, an additional 1.9% in 2013, and an additional 2.0% in 2014. Similarly, the introduction of gender explained an additional 0.008% of variance in CAUTI incidence after controlling for age in North Carolina in 2012, an additional 0.7% in 2013, and an additional 0.004% in 2014. I also found a relationship between gender and CAUTI incidence between 2012 and 2014.

A logistic regression analysis was conducted to test if there was a relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014. In New York, the odds of developing CAUTI was the highest with the Age Group 65-84, followed by Age 85+, Age Group 45-64, and Age Group 18-44 years in 2012. The odds of developing CAUTI were the highest with Age Group 85+ in 2013 followed by Age 65-84, Age 45-64, and Age 18-44 years. The odd of developing CAUTI were the highest with the Age Group 85+ in New York in 2014 followed by Age 65-84, Age 45-64, and Age 18-44 years in 2014.

In North Carolina, the odds of developing CAUTI were the highest with the Age Group 18-44 followed by Age 45-64, Age 85+, and Age 65-84 years in 2012. The odds of developing CAUTI were the highest with the Age Group 45-64 followed by Age 85+, Age 18-44, and Age 65-84 years in 2013. The odds of developing CAUTI were the highest with the Age Group 85+ followed by Age 45-64, Age 65-84, and Age 18-44 years in 2014. I found that the odds of getting CAUTI were much higher among age>= 45 compared to the <17 years.

A hierarchical logistic regression analysis was conducted to test if there was a relationship between age and CAUTI incidence in New York and North Carolina between 2012 and 2014 after controlling for gender. I found that there was a significant relationship between age and CAITI incidence after controlling for gender in New York and North Carolina between 2012 and 2014, except in North Carolina in 2013. The model was not significant in North Carolina in 2013, indicating that age was not significantly related to CAUTI incidence after controlling for gender in North Carolina in 2013.

In the findings generated from the HCUP website on hospital types and CAUTI in New York and North Carolina, I found that the incidence of CAUTI in New York and North Carolina in 2012, 2013, and 2014 did vary to a significant degree by hospital types categorized as government-owned, private not-for-profit, and private for-profit.

In New York, private not-for-profit hospitals consistently demonstrated a higher incidence of CAUTI in patients than government-owned hospitals in 2012, 2013, and 2014. In North Carolina, government-owned hospitals consistently had a higher incidence of CAUTI patient than private, not-for-profit hospitals and private, for-profit hospitals from 2012 to 2014. However, it should be noted that a higher number of CAUTI patient discharges does not necessarily translate to a higher incidence of CAUTI by hospital types. The ratio of the number of hospitals by the number of CAUTI incidences also indicated the same result of higher incidence of CAUTI in patients in private, not-for-profit hospitals in New York and higher incidence of CAUTI in government-owned hospitals. Because there were no data to statistically determine the relationship between hospital types and CAUTI incidence, it is recommended that future research be conducted to establish the relationship of hospital type and CAUTI incidence.

This study adds to the existing literature on the relationship between hospital types, gender, age, and the incidence of CAUTI in New York and North Carolina between 2012 and 2014. I hoped to advance knowledge in the health care practice in New York and North Carolina by influencing policy-making in the prevention of CAUTI in our hospitals. These findings fit in with the extant literature that there was a significant relationship between age and CAUTI. The study could be used in furthering health care providers' understanding of factors that contributed to CAUTI in New York and North Carolina between 2012 and 2014.

Garibaldi et al. (1974) found that age plays significant roles in CAUTI. Four hundred and five hospitalized patients with indwelling urinary catheter drainage showed 23%developed infection. Garibaldi et al. (1974) found that the risk was greater in elderly patients. Gould et al. (2010) found that age was correlated with CAUTI. Gillen et al. (2015) selected patients undergoing cardiac surgery from 2006 through 2012 and found that older age was significantly associated with CAUTI. These findings fit in with literature in that there was a significant relationship between gender and incidence of CAUTI. Findings confirmed knowledge in the discipline.

Garibaldi et al. (1974) found that gender was significantly correlated with CAUTI. Temiz et al. (2012) selected male and female patients with an indwelling urinary catheter in the Zonguldak Karaelmas University Hospital intensive care unit, finding that gender was associated with CAUTI. Gillen et al. (2015) found that female gender was significantly associated with CAUTI.

In this study, the characteristics of patients such as gender and age are linked with CAUTI in New York and North Carolina between 2012, 2013, and 2014. These findings fit in with the theoretical framework. The first component of Donabedian model is the structure. The structure comprises all factors that affect the context in which care is delivered and the characteristics of patients such as age and gender. (McDonald et al., 2007).

Theoretical Implications

The Donabedian theory guides the present study. Dimick (2010) explained that while there are different types of quality measurements, nearly all quality measures could be classified into one of Donabedian three dimensions (structure, process, and outcome) to measure healthcare quality. The model has been used to determine the characteristics of patients (i.e., age, gender) that are related to patients' care quality (Aday et al., 2004). The Donabedian model ties into this study because it can be used to explain how structure such as the characteristics of patients (age, or gender) in each state, city or jurisdiction can determine the CAUTI outcome.

The findings made a meaningful contribution to the advancement of the Donabedian theory because the model continues to help guide policy makers and users to improve healthcare outcomes (Dimick, 2010). I applied the Donabedian theory to the research topic and examined the impact of gender and age on the incidence of CAUTI.

Limitations of the Study

There are the limitations to generalizability (Leedy & Ormrod, 2016). The target population was men and women receiving medical care in New York and North Carolina who had received an indwelling urinary catheter between January 1, 2012, and December 31, 2014. Considering that New York and North Carolina may not represent all states, therefore, findings cannot be generalized to other states (Remler & Van Ryzin, 2010).

I examined the relationship between age and CAUTI and the results showed a significant relationship. There may be a need for the study to control some factors such as education levels and socioeconomic status using a hierarchical regression analysis

(Remler & Van Ryzin, 2010). The education levels and socioeconomic status variables were not available a higher number does not necessarily equate to a higher proportion. Controlling for education levels and socioeconomic status could result in stronger results from similar studies.

The data were analyzed based on the self-reported scores by the hospitals. The participants could be biased. The reliability and the content validity of the survey were not tested. Reliabilities should be greater than 0.70 (Nunally, 1978). Testing the reliability and content validity would result in stronger results from similar studies (Leedy & Ormrod, 2016).

Recommendations

This study was conducted on data collected from acute care settings. Future studies could include data from all healthcare facilities including long-term care facilities and community clinics. There is need to perform detail analysis of the influence of hospital types (i.e., government-owned, private not-for-profit, and private for-profit) on CAUTI that could not be done in this study due to the non-availability of data in the right format time frame and other practical considerations.

Healthcare providers can employ the findings of this study to develop treatment plans and procedures that are age appropriate and gender-specific that could help control the incidence of CAUTI in New York and North Carolina. The knowledge gained from this study can be used to develop strategies to manage differences in the incidence of CAUTI and evaluate factors that predict the incidence of CAUTI in New York and North Carolina. There seems to be a higher odd of getting CAUTI among age group 18-44years in 2012 compared to your reference age group in North Carolina in 2012. This may require further investigation as to why the inconsistency.

Implications for Positive Social Change

This study offers potential positive social change by showing that there is a significant relationship between gender, age, and CAUTI in New York and North Carolina. The study may provide an understanding of patients with CAUTI and the structure they need during care. The social change implications of the study include the knowledge gained that can influence policies that are age-appropriate, gender-specific, and facility tailored to reduce the incidence of CAUTI. This study helps researchers to realize that age, gender, and hospital type, may affect the incidence of CAUTI. Furthermore, the study could be beneficial to healthcare organizations and professionals who care for patients with an indwelling urethral catheter.

Conclusion

CAUTI is an important factor for health care quality improvement that affects the patient's quality of life and services received in healthcare facilities. It also affects the reimbursement of services provided by healthcare facilities. With the increasing importance of preventing HAI including CAUTI, I evaluated gender, age and hospital types as risk factors for acquiring CAUTI in patients.

The findings of this study are that there is statistical significant relationship between gender and CAUTI in New York and North Carolina between 2012, 2013, and 2014. These finding fit in with previous literature in that age and gender significantly affected CAUTI. Results confirmed knowledge in the discipline. This study may influence positive social change by acting as a guide in formulating policies that are age appropriate, gender-specific, and facility tailored to reduce the rate of CAUTI. This study may help health care practitioners plan for projects to decrease the incidence of CAUTI. The study could assist policy makers implement policies that are age appropriate, gender specific, and facility tailored to benefit patients with an indwelling urethral catheter in the hospital.

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