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E-learning Programs for Hospital Based Nurses

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E-learning Programs for Hospital Based Nurses

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Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

December 2016

Dedication

I would like to dedicate this to my family. My husband and three children have been tremendously supportive, tolerant, and patient as I sacrificed time with them in order to pursue this degree. I could not have accomplished this without their support, especially the support of my amazing husband who always encouraged me to continue. I wish to also dedicate this to my father who always dreamed of receiving a PhD and was so proud of me for my pursuit. He passed unexpectedly and suddenly two years ago and it was a huge barrier to my continuation in this program but I did knowing that it is what he would have wanted.

Acknowledgements

E-learning Programs for Hospital Based Nurses

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The University of Texas at Austin, 2016

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E-learning is emerging as an increasingly popular methodology for the delivery of continuing education (CE) for nurses. However, there is a lack of theoretically driven research that examines the effectiveness of e-learning programs for hospital nurses. The purpose of this study was to use the Kirkpatrick Theory (Kirkpatrick, 1994) to evaluate an existing e-learning program for hospital nurses, "Preventing Catheter Associated Urinary Tract Infections (CAUTIs)" (as an exemplar) to examine outcomes associated with e-learning programs for hospital nurses. Nurses were recruited from a large metropolitan hospital that has been using e-learning for CE for their hospital based nurses for 10 years. The study was a theory driven, mixed methods design that used surveys, tests, and patient outcomes as measures to determine the effectiveness of the e-learning program exemplar, Preventing CAUTIs. Data was collected at three time points: before the e-learning program, immediately after the e-learning program completion, and one month after the e-learning program completion. There were 48 nurses enrolled in the study, 46 who completed all elements. The findings were that nurses found the e-learning program useful. Their test scores had a statistically significant increase from pre-test to post-test 1 ($p<0.001$) and from pre-test to post-test 2 ($p<0.001$). Scores decreased at the one month time point (post-test 2) but remained statistically higher than pre-test scores ($p<0.001$). Thus, reflecting some gains immediately after e-learning program

completion and knowledge retention at one month post e-learning program. The patient outcome of CAUTI rates was measured throughout the study time period and one month after e-learning program completion. CAUTI rates decreased in the entire time period following the e-learning program implementation. Nurses self-reported that they were confident, committed, and motivated to utilize the e-learning program in their nursing practice. This was the first study with an e-learning program for hospital nurses to employ an entirely theory driven design that examined all aspects of the theory utilized. This study provided evidence that Kirkpatrick (1994) theory is a useful theory for use in examination of e-learning programs for nurses. Future use of this theory should incorporate measures of all of the four steps (reaction, learning, behavior, and results) and the concepts of climate and rewards. Other areas of future research include: examination of knowledge and patient outcomes beyond one month post e-learning program completion, more open-ended research questions to examine the concepts of rewards and climate, and other ways to assess results.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

In this chapter, the topic for the proposed study is introduced. First the background, significance, and purpose of the study are described. Next the theoretical framework of the study is discussed and the research questions derived from the theoretical framework are presented. Next, the assumptions and limitations of the proposed study are discussed. Finally, the importance and need for the study is summarized.

BACKGROUND AND SIGNIFICANCE OF THE PROBLEM

The continuing education (CE) of nurses is essential to increase and update knowledge to positively impact patient care (IOM, 2010). The American Nurses Association (ANA) and National Nursing Staff Development Organization define CE as, "learning experiences that augment the knowledge, skills, and attributes of nurses and enrich their contributions to quality healthcare and their attainment of professional goals" (2010, p. 83; ANCC 2012). The American Nurses Credentialing Center (ANCC) defines CE as, "learning activities that build upon the registered nurse (RN) knowledgebase to enhance practice, and education to improve the health of patients and support the advancement of professional goals" (ANCC, 2011, p.106; ANCC, 2012). Leading healthcare organizations, such as the Joint Commission (TJC), the Institute of Medicine (IOM), and the Tri-Council for nursing, support nursing education, including CE, as one means to improve patient safety (IOM, 2010; TJC, 2010; Tri-Council for Nursing, 2010). There are numerous options available to receive CE such as meetings, conferences,

classroom education, in-services, and lectures (American Association of Colleges of Nursing (AACN) & Association of American Medical Colleges (AAMC) Macy report, 2010).

E-learning is an internet based teaching method that can provide CE for nurses (Aparicio, Bacao, & Oliveira, 2016; McClure, 2012; Twomey, 2004, p.453). Its use is supported by the authors of Healthy People 2020 and the IOM to maintain competence and improve patient outcomes (Healthy People, 2020; IOM, 2010). Additionally, e-learning programs are utilized by nursing professional organizations, hospitals, and national organizations such as the Centers for Disease Control (CDC) and the Joint Commission (TJC).

E-learning is used by 77% of United States (U.S.) companies and at least 50% of U.S. hospitals and its use is increasing (McClure, 2012; Pappas, 2015). E-learning is used to provide CE to nursing staff, to maintain competencies, evaluate performance, and improve outcomes (Phillips, 2005; Spiva, Johnson, Robertson, Barrett, Jarrell, Hunter, & Mendoza, 2012). The large movement toward the increasing use of e-learning for hospital nurses may be due to the many benefits of e-learning. These benefits include: mass availability, convenience, accessibility, standardized approach, cost reduction, versatility, and efficiency (Ally, 2004; Johnson, Robertson, Barrett, Jarrell, Hunter, & Mendoza, 2012; Phillips, 2005; Seiler & Billings, 2004; Spiva, et al., 2012). Research has compared hospital based e-learning programs for nurses to traditional classroom based programs and found that the programs are equally effective for knowledge acquisition (Kontio, Lahti, Pitkanen, Joffe, Putkonen, Hatonen, & Valimaki, 2011; Moule, Albarran, Bessant, Brownfield, & Pollock, 2008; Spiva, et al., 2012). E-learning allows for self-directed learning and assists with the development of computer skills (Lewis, Davies, & Jenkins,

2001; Phillips, 2005). E-learning programs provide a means to standardize educational programs and are able to reach large numbers of nurses in a short time period. Additionally, these programs provide education that is available 24/7 to nurses that work weekends and night shifts when a nurse educator may not be available (Philips, 2005).

While these benefits are significant, there are barriers to e-learning. The largest barrier to e-learning is low computer literacy (Gerkin, Taylor, & Weatherby, 2009; Patel, 2007; Straight, 2008). Nurses may struggle with the use of e-learning technology depending on their level of computer literacy (Howatson-Jones, 2004). Nurses may become dissatisfied or discouraged by e-learning programs if they cannot navigate through the material and spend excess time trying to learn the technology along with the e-learning content (Howatson-Jones, 2004). In one study, there was a correlation between the ease of use of the e-learning technology, adequate preparation for use of the e-learning technology and satisfaction with the e-learning program (Patel, 2007). Orientation to the use of e-learning technology may be an important factor in nurse satisfaction and success observed with e-learning programs (Straight, 2008).

Another possible barrier to e-learning is ethnicity/culture. Although there are no empirical studies to support this, there is a sparse amount of the literature that discusses ethnicity/culture as a potential barrier to the success of e-learning programs. The literature mentions language used in e-learning as an area that may negatively affect foreign born nurses who practice in the U.S. especially if English is their second language (Ubon, 2002). Ubon (2002) discusses the lack of personal interaction with e-learning programs that may affect usage by persons from cultures not accustomed to this. Muilberg & Berge (2005) mention that the lack of social interaction in the e-learning

3

environment impacts individuals from all cultures and should be considered when evaluating success of e-learning programs.

Some literature has mentioned that learning style and learning disabilities may negatively affect e-learning program success. Though this has not been substantiated through empirical studies, the literature recommends thorough planning and assessment of these issues prior to designing e-learning programs to negate these potential negative effects on program success (Howatson-Jones, 2004). While the barriers to e-learning programs are important issues to consider; these issues have not slowed the expansion of e-learning programs across the U.S. Due to the widespread and increasing use of e-learning, it is important to evaluate its effectiveness in spite of the possible barriers. The benefits of e-learning programs for hospital based nurses far outweigh the barriers.

NEED FOR EVALUATION OF E-LEARNING PROGRAMS

There are 44,000-98,000 deaths and greater than 1 million injuries in hospitals annually from preventable medical errors in the United States (U.S.) (IOM, 1999). The estimated annual cost of preventable medical errors in the U.S. is $17-$29 billion (IOM, 1999). While this information is dated, it was this information that brought the issue of medical errors to prominence within hospitals (Bleich, 2005). The Institute of Medicine (IOM) data (1999) is still widely used in hospitals to address the issue of medical errors and medical error reduction. The IOM data also included a larger sample size than what has been used in newer studies and that contributes to its continued use (James, 2013). However, newer data suggests that there are higher instances of medical errors than the IOM reported. James (2013) estimated that preventable patient deaths in the U.S. due to medical errors range from 210,000-400,000 per year. Makary and Daniel (2016) suggest that the rate is higher due to inconsistencies or lack of reporting cause of death on death

certificates and that medical error may be the 3rd leading cause of death in the U.S. One type of preventable medical error is the catheter associated urinary tract infection (CAUTI) (CDC, 2015). CAUTIs are the most commonly reported healthcare acquired infection with approximately 93,300 CAUTIs in U.S. hospitals annually and 15%-25% of hospitalized patients have a urinary catheter inserted their treatment (CDC, 2015; CDC, 2016; Magill, S., Edwards, J., Stat., M., Bamberg, W,. Beldavs, Z., Dumyati, G., M.D., Kainer, M., Ruth Lynfield, R., Maloney, M., McAllister-Hollod, L., Nadle, J., Ray, S., Thompson, D., Wilson, L., & Scott K. Fridkin, S., 2014). The estimated yearly cost of CAUTIs is $250 million (Agency for Healthcare Research and Quality (AHRQ), 2015). CAUTIs may progress and result in additional complications and infections (CDC, 2016; Scott, 2009). "CAUTIs have been shown to prolong a patient's hospital stay, increase healthcare costs, increase mortality, increase morbidity, and lead to more than 13,000 deaths per year in the U.S." (CDC, 2016; Klevens, Edward, Richards, Horan, Gaynes, Polluck, & Cardo, 2007).

Nurses are at the forefront of hospital care. There are 3.1 million registered nurses (RNs) in the US and 62.2% work in hospitals (ANA, 2011). Nursing is one of the fastest growing professions with an expected growth of 22% from 2008 to 2018 (ANA, 2011). Nurses are in a key position to enhance the quality of patient care in hospitalized patients by preventing CAUTIs (Cullen, Bates, & Leape, 2001; Gould, Umscheid, Agarwal, Kuntz, & Pegues, 2009; Rothschild, Landrigan, Cronin, Kaushal, Lockley, Burdick, Stone, Lilly, Katz, Czeisler, & Bates, 2005). Nurses are primarily responsible for the insertion and maintenance of urinary catheters. This places nurses in a key position to decrease rates of CAUTIs thus improving patient outcomes and enhancing patient safety.

Leading healthcare organizations, such as the Joint Commission (TJC), the Institute of Medicine (IOM), and the Tri-Council for nursing, support nursing CE, as one means to improve patient safety and outcomes (IOM, 2010; TJC, 2010; Tri-Council for Nursing, 2010). E-learning is one way to deliver this CE. With its increasing prevalence in hospitals, it is important that research is conducted to evaluate it.

The nursing e-learning literature is sparse in its discussion of theory for evaluation purposes. The majority of nursing e-learning research studies reviewed did not mention the use of theory in the evaluation of the program effectiveness (Alemagno, Guten, Warthman, Young, & Mackay, 2010; McTigue, D'Andrea, Doyle-Munoz, & Forrester, 2009; Moule et al., 2008; Straight, 2008). Of the e-learning nursing studies reviewed that utilized theory in the design, none provided a thorough description of the theoretical framework (Hart, Eaton, Buckner, Morrow, Barrett, Fraser, & Sharrer, 2008; Schneidermann, Corbridge, & Zerwic, 2009). In two studies, theory was mentioned very briefly and theory was not included as an essential guide to the study design or implementation (Hart et al., 2008; Schneidermann et al., 2009). This is a critical gap in the literature as theory plays a significant role in research design, conduct, and interpretation of findings. Furthermore, it is especially difficult to interpret research findings without a theoretical basis from which to draw insights, formulate conclusions, and guide future research.

As the prevalence and usage of e-learning increases for hospital based nurses, it is important to examine its effectiveness and identify best practices for design and evaluation (IOM, 2010, Twomey, 2004). This examination will ensure that e-learning programs meet the educational needs of nurses and contribute to improvements in patient outcomes (IOM, 2010). This chapter will outline a proposed theoretically based research

study to examine the effectiveness of e-learning programs for hospital nurses using an e-learning program exemplar.

PURPOSE OF THE STUDY

The purpose of this study was to use the Kirkpatrick theory (Kirkpatrick, 1994) to evaluate an existing e-learning program for hospital nurses, "Preventing CAUTIs" (as an exemplar) to examine outcomes associated with e-learning programs for hospital nurses. It is essential that e-learning be evaluated using a systematic, theoretically based approach. Evaluation of e-learning is important to both substantiate this educational method and to design more effective e-learning programs for hospital nurses. This study provided a theoretically based approach for the evaluation of the e-learning program, "Preventing CAUTIs" (as an exemplar) and contributed to the research of e-learning program evaluation. Contributing to the research on evaluating e-learning programs for hospital based nurses is important so that the most effective e-learning programs are designed to enhance patient outcomes.

THEORETICAL FRAMEWORK

The dissertation study utilized the Kirkpatrick theory (1994) to evaluate an existing hospital based e-learning program for hospital nurses, preventing CAUTIs (as an exemplar).

Theory: Kirkpatrick (1994) published a four step program evaluation theory that he began to develop in the 1950s. The theory describes four essential steps to the evaluation of the effectiveness of learning programs. "Effectiveness is defined as the production of an intended result or effect" (Merriam Webster, 2014). This theory was

developed to guide program evaluation to determine the effectiveness of learning programs (Kirkpatrick, 1994).

Explanation of the theory: According to Kirkpatrick (1994), this effectiveness evaluation is performed via a multi-step (four step) process. Each of the steps are used for evaluation purposes and outcomes of the evaluation are targeted at, "learner satisfaction, increasing knowledge or skills, changing behavior, and getting better results (Kirkpatrick, 1994, p. xiv). The steps described in the theory proceed sequentially and steps should not be skipped (Kirkpatrick, 1994). Each step provides data that informs the next step and that the researcher uses to determine the overall program effectiveness. Measurement should occur at each step of the process if possible (Kirkpatrick, 1994). According to Kirkpatrick (1994), if it is not feasible to measure all steps, the ones that are measured still must proceed sequentially as described in the Kirkpatrick theory (figure 1.1).

Figure 1.1: Theoretical Framework for Determining E-Learning Program Effectiveness

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                              ┌─────────────────┐
                              │    Climate      │
                              │ (Participant    │
                              │ self-report     │
                              │ behavior tool)  │
                              └────────┬────────┘
                                       │
                                       ▼
┌──────────────┐  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
│  Step 1:     │  │  Step 2:     │  │  Step 3:     │  │  Step 4:     │
│  Reaction    │→ │  Learning    │→ │  Behavior    │→ │  Results     │
│ (Participant │  │  (Pre-       │  │ (Participant │  │ (Number of   │
│  reaction    │  │  test/post-  │  │  self-report │  │  CAUTIs)     │
│  tool)       │  │  test)       │  │ behavior     │  │              │
│              │  │              │  │  tool)       │  │              │
└──────────────┘  └──────────────┘  └──────────────┘  └──────────────┘
                                       ▲
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                              ┌────────┴────────┐
                              │    Rewards      │
                              │ (Participant    │
                              │ self-report     │
                              │ behavior tool)  │
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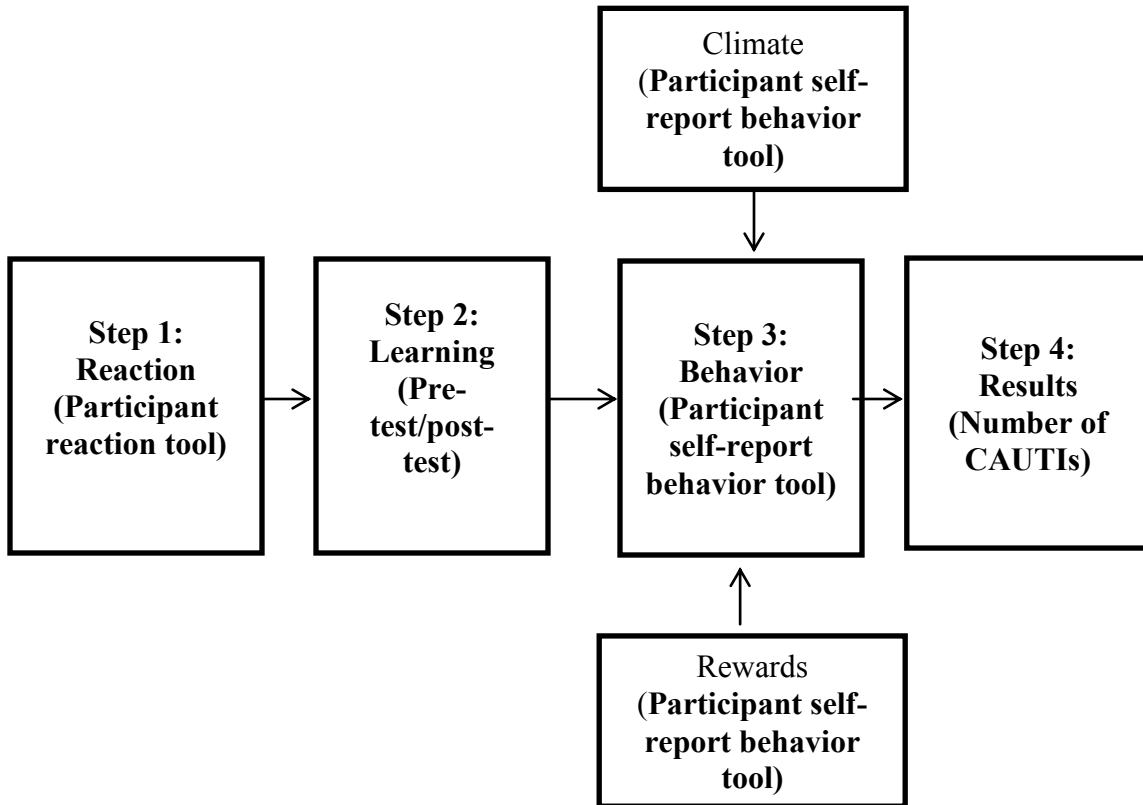
Step One Reaction: The first step is to evaluate the concept of reaction. "Reaction is how those who participate in the program respond to it and their responses indicate how well participants like a program" (Kirkpatrick, 1994, p. 21). Reaction to a program could be positive or negative and could affect the second step of the process, learning. A positive reaction indicates receptivity to the information presented in the program and may increase learning; whereas, a negative reaction to a program may decrease the magnitude of learning (Kirkpatrick, 1994). Reaction is most often measured

using an end of course evaluation tool and occurs immediately after program completion and before step two of the process (learning). For this proposed study, a reaction tool developed by Kirkpatrick (Kirkpatrick Partners, 2011) was used to evaluate participant reaction immediately after completion of the e-learning program.

Step Two Learning: The concept of learning (step two) is defined as, "the extent to which participants change attitudes, improve knowledge or confidence, and/or increase skills, as a result of completing the program" (Kirkpatrick, 1994, p.22). One example of measurement at this level is the use of pre and post-testing to evaluate knowledge acquisition. According to the Kirkpatrick theory (1994), there must be a positive impact on learning in order for the third step, behavior, to be impacted.

Step Three Behavior: The concept of behavior (step three) is defined as, "the extent to which a change in actions has occurred as a result of the participant completing the educational program" (Kirkpatrick, 1994, p.22). It is the transfer of the skills learned from the program to practice through the application of knowledge (Kirkpatrick, 1994). Behavior change is dependent upon learning (step two). In this theory, behavior change will not occur without learning. Additional factors that may impact behavior change are: climate and rewards (intrinsic and extrinsic). "Climate, is defined as the environment of the workplace established by the management/leadership" (Kirkpatrick, 1994, p. 23). A climate that fosters behavior change is neutral, encouraging, and/or requiring. According to the theory, if a climate is preventing (management prevents the participant from changing behavior) or discouraging (behavior change is discouraged), behavior change will not take place (Kirkpatrick, 1994). Without the right climate, participants may not try to use what they have learned. Intrinsic rewards are defined as, "rewards that originate from within an individual such as: personal satisfaction, pride, and sense of achievement"

10

(Kirkpatrick, 1994, p. 23). Extrinsic rewards are defined as, "rewards that come from outside such praise, recognition, monetary raise, promotion, reward, or award as a result of successful completion of the program" (Kirkpatrick, 1994. p. 24). Intrinsic and/or extrinsic rewards support behavior change (step three). In this study, behavior change, climate, and rewards will be measured by self-report using a modified version of an existing Kirkpatrick tool (Kirkpatrick Partners, 2011).

Step Four Results: The fourth step of the process is results. Results are defined as, "the final outcome that occurred because the participants completed the program" (Kirkpatrick, 1994, p. 25). "Results, could be operationalized as cost, productivity, quality, sales, employee turnover, patient outcome, or job satisfaction" (Kirkpatrick, 1994, p. 25). The result chosen for measurement should be meaningful and related to the program. It may be difficult to determine if the results are directly related to the program because there are other factors that affect results (Kirkpatrick, 1994). It is important to disclose additional factors that may impact results and to have measurement at steps 1-3 as evidence of program effectiveness (Kirkpatrick, 1994). In this study, patient outcomes are the 'results' and will be measured by the number of CAUTIs. This outcome (results) will be measured before and after the CAUTI e-learning program for comparisons.

Each step of this process described by the Kirkpatrick theory (1994) provides important information for the next step of the process. All of the steps measured together provide information to the researcher to determine if a program is effective in achieving the desired outcomes. And if the program was not effective, then data from each step may inform decisions about possible reasons that a program was not effective (Kirkpatrick, 1994). For example, a program may be effective at steps one and two, but not at steps three and four. Climate may be an explanation for this, or extraneous factors such as high

nurse stress, workload, or a lack of adequate supplies necessary to apply knowledge, may be influencing factors for poor outcomes (Kirkpatrick, 1994).

WIDESPREAD USE OF THE KIRKPATRICK THEORY

The Kirkpatrick theory (1994) is cited in the literature for many disciplines including healthcare and is used by healthcare organizations internationally to evaluate learning programs (Bharat, Boet, Bould, Birze, Naik, Reeves, & Grantcharov, 2011; Lin, Chien, Tai, & Lee, 2006; Sears, Cohen, & Drope, 2008;). Several CE authors used the Kirkpatrick theory (1994) to synthesize the literature (Gillian, Lovrics, Halpern, Wiljer, & Harnett, 2011; Smidt, Balandin, Sigfoos, & Reed, 2009; Yardley & Dornan, 2012). The Kirkpatrick Theory (1994) provides a useful, multi-step approach for the evaluation of learning programs (Kirkpatrick, 1994). The linear nature of the theory is functional and purposeful such that the evaluation of learning programs consists of more than the use of a single immediate post-test. It is complex in that it incorporates four steps of the evaluation process so that more data can be utilized to determine program effectiveness (Kirkpatrick, 1994). All four of the evaluation steps described in the theory are useful when applied to e-learning programs for nurses in the hospital. This is a unique population and setting that consists of rapid change, challenges, and complexities that support the use of e-learning as a teaching method. E-learning programs for hospital based nurses must be adequately evaluated so that the most effective e-learning programs are designed and enhance patient outcomes.

Within the realm of e-learning programs for hospital nurses, there is little theoretically based research on program effectiveness. The use of e-learning for hospital nurses continues to expand despite this paucity of empirical evidence evaluating its effectiveness. It is necessary to fill this knowledge gap by conducting theoretically

12

guided research on e-learning program effectiveness in order to implement the most effective programs that positively impact patient outcomes. Kirkpatrick's Theory (1994) provides a useful and novel approach to the evaluation of e-learning programs in this population and setting.

KNOWLEDGE RETENTION

In addition to the lack of theoretically based research regarding e-learning programs for hospital nurses, there is a lack of evaluation of knowledge retention beyond immediate post program evaluation. There are few studies that have reviewed the effectiveness of e-learning programs for nurses within the hospital setting and no empirical studies were identified that evaluated hospital nurses' knowledge beyond that measured immediately after e-learning program completion (Alemagno et al., 2010; Gerkin et al., 2009; Hart et al., 2008; McTigue et al., 2009; Moule et al., 2008; Patel, 2007; Schneidermann et al., 2009; Spiva et al., 2012; Straight, 2008). It is important to include knowledge retention in evaluation of e-learning programs because knowledge must be retained in order to be utilized in practice and impact patient outcomes over the long-term. The Kirkpatrick theory (1994) supports the evaluation of knowledge retention using repeated measurements at appropriate time intervals, though no specific time intervals are delineated in the theory. The theory leaves the establishment of time intervals for the measurement of knowledge retention to the researcher.

This dissertation study evaluated knowledge acquisition immediately following program completion and at one month after program completion. The time point of one month was chosen based on literature regarding knowledge retention. Literature suggests that persons completing a one hour learning program will have a 2-3% percent knowledge retention at one month post learning (University of Waterloo, 2014).

13

Hamilton (2005) suggests that skills retention declines faster than knowledge retention and may show decreases in as little as two weeks. Knowledge retention may decrease in 3-6 months (Hamilton, 2005). Additionally, literature discusses variations in retention rates depending on the type of knowledge and one study by Cohen, Conway, and Stanhope (1992) found a 58% decrease in recall of concepts after 3 months. Custers (2010) discusses contributors to knowledge retention are: thoroughness of the program, time frame for retention measurement, and amount of reinforcement.

There is no consensus in the literature regarding a standard time for measurement of knowledge retention. Further, there is no literature regarding e-learning and knowledge retention for hospital nurses. Since many e-learning programs for nurses within the hospital setting are used for annual education, evaluation of knowledge at one month post program is important to ensure knowledge retention and enhancement of patient outcomes.

STATEMENT OF THE PROBLEM

Aim: To examine multi-step outcomes using the Kirkpatrick Theory (1994) for an established e-learning program, "preventing CAUTIs" as an exemplar for e-learning programs for hospital nurses.

RQ 1: What are the reactions of nurses to the e-learning program, preventing CAUTIs?

RQ 2: What is the effect of the e-learning program, preventing CAUTIs, on knowledge acquisition immediately after program completion and at 1 month after completion of the e-learning program?

RQ 3: In what ways did completion of the e-learning program, preventing CAUTIs, impact the nurse's self-reported behavior change one month after e-learning program completion?

RQ 4: What is the impact of climate and rewards on the application of e-learning program knowledge by nurses?

RQ 5: What is the impact of the e-learning program, preventing CAUTIs, on CAUTI rate?

RQ 6: What are the relationships between nurses' reactions to, learning from, application of knowledge, and impact on results (CAUTI rate) after completion of the e-learning program, preventing CAUTIs?

DEFINITIONS OF TERMS

1. <u>Behavior</u>: Behavior is defined as, "the extent to which a shift in actions has occurred as a result of the participant completing an educational program" (Kirkpatrick, 1994, p.22). Behavior was operationalized as participant self-evaluation of behavior change using a modified version of an existing Kirkpatrick tool (Kirkpatrick Partners, 2011).

2. <u>Catheter associated urinary tract infection (CAUTI)</u>: CAUTI is defined as, "the occurrence of germs (usually bacteria) entering the urinary tract through the urinary catheter and cause infection" (CDC, 2015). CAUTI was operationalized as rate of CAUTIs for a hospital or specific unit within a hospital.

3. <u>Climate</u>: "the environment of the workplace established by the management/leadership" (Kirkpatrick, 1994, p. 23). Climate was operationalized as an environment that: encourages, prevents, or discourages behavior change.

4. <u>Continuing education (CE)</u>: "learning activities intended to build upon the educational and experiential bases of the professional RN for the enhancement of practice, education, administration, research, or theory development, to the end of improving the health of the public and RN's pursuit of their professional career goals" (ANCC, 2011, p.106). This was operationalized as an e-learning program for hospital nurses to prevent CAUTIs.

5. Effectiveness: "producing a result that is wanted; having an intended effect" (Merriam Webster, 2014). This is operationalized as a program successfully achieving its intended outcomes/objectives which for this study, the outcome is to decrease CAUTIs.

6. E-learning: "an internet teaching method that can provide CE for nurses" (Aparicio, et al., 2016; McClure, 2012). This is operationalized as an internet based program that delivers an educational program, preventing CAUTIs to hospital based nurses.

7. Extrinsic rewards: "are rewards that come from outside such as: praise, recognition, a monetary raise, promotion, reward, or award as a result of completing a program" (Kirkpatrick, 1994, p. 53). This was operationalized as a reward provided to a nurse for e-learning program completion such as CE hours or a raise.

8. Intrinsic rewards: "are rewards that originate from within an individual such as: feelings of personal satisfaction, pride, and a sense of achievement as a result of completing a program" (Kirkpatrick, 1994, p. 53). This is operationalized as a reward perceived by the nurse upon program completion such as personal satisfaction.

9. Learning: The concept of learning (step two) is defined as, "the extent to which participants change attitudes, improve knowledge, and/or increase skills, as a result of completing the program" (Kirkpatrick, 1994, p.22). This was operationalized as knowledge pre and post score differences.

10. Nurse: "person that protects, promotes, and optimizes health and abilities, prevents illness and injury, alleviates suffering through the diagnosis and treatment of human response(s), and advocates for quality care of individuals, families, communities, and populations" (ANA, 2015). This was operationalized in this study as a nurse that works in a hospital medical surgical unit, full-time or part-time in direct care of patients with urinary catheters.

11. <u>Reaction:</u> "how those who participate in the program respond to it and it indicates how well participants like a program" (Kirkpatrick, 1994, p. 21). This is concept can be measured as an end of course evaluation tool or a measurement of participant satisfaction immediately after program completion (Kirkpatrick, 1994). This was operationalized as participants' scores on a reaction tool completed immediately after the e-learning program completion (Kirkpatrick Partners, 2011).

12. <u>Results</u> "are defined as the final outcome that occurred because the participants completed the training program" (Kirkpatrick, 1994, p. 25). This is operationalized as: employee retention, quality improvement and impacts on leadership, productivity, or patient outcomes. In this study, rates of CAUTIs were measured.

13. <u>Urinary tract infection (UTI)</u>: "is an infection involving any part of the urinary system, including urethra, bladder, ureters, and kidney" (CDC, 2015). This was operationalized as measurement of catheter associated UTI rates.

ASSUMPTIONS

The following assumptions were made for this dissertation study:

1. There are multiple steps/levels required to evaluate the effectiveness of an e-learning program.

2. Hospital based nurses wanted to participate in this study and answered questions honestly.

3. Prevention of CAUTIs is an important topic that can be addressed via an e-learning program.

4. Technical skills of the nurses did not prevent them from accessing and/or completing the e-learning program because they have had a thorough orientation to and prior use of the LMS during their new employee orientation program.

17

5. The e-learning program was designed and implemented with expert nurse consultation and based on up to date CDC standards.

6. The e-learning program was implemented as intended.

7. The pre-test and post-tests were designed by nurse educators and infection control nurses based on objectives and content contained in the e-learning program.

8. Measures used in this study had good psychometric properties.

LIMITATIONS

The possible limitations of this dissertation study included:

1. A convenience sample of hospital based nurses employed by one hospital in a southern state. This sample may not have been representative of all hospital based nurses utilizing e-learning CAUTI prevention CE.

2. The sample included hospital nurses only, thereby limiting the generalizability of the study results to other populations utilizing e-learning for CE.

3. The study design was a one group repeated measures design. There was no control group for comparison so there is a risk that measurements are correlated. The adjustment made for this required a larger F value for significance (Borich, 2012).

4. Nurses are not the only healthcare providers that may be involved in care of urinary catheters. Non-licensed assistive nursing personnel (NAP) may provide urinary catheter care such as perineal care and emptying indwelling catheters. Thus, NAP may have impacted the rates of CAUTIs.

5. Nurses prior to completing the e-learning program may have been exposed to some of the e-learning program information by nurse managers or nurses that had already completed the e-learning program.

IMPORTANCE OF AND NEED FOR THE STUDY

Lifelong learning is essential to the progression of the nursing profession and enhancement of patient outcomes, so there is a need to continue research in this area to develop and identify best practices (Billings et al., 2005). Currently there is a lack of theoretically supported/guided research to evaluate e-learning programs for hospital based nurses. This is an important area for research as the number of e-learning programs continues to increase without empirical evidence of its effectiveness on knowledge retention beyond immediate post-test. This study contributed to the literature by providing a theoretically guided evaluation of an e-learning program, "preventing CAUTIs" that may be utilized in future research to determine the effectiveness of e-learning programs for hospital based nurses. Enhancement of patient care depends in part on knowledgeable nurses; e-learning programs provide this knowledge. As such, a solid research base is warranted so that e-learning programs for nurses are most effective. As such, empirical evidence is needed to support the development and evaluation of the most effective e-learning programs for hospital nurses.

SUMMARY

This chapter discussed the background, significance, theoretical framework, purpose, and research questions for this dissertation study. The purpose of this study was to use the Kirkpatrick theory (Kirkpatrick, 1994) to evaluate an existing e-learning program for hospital nurses, "Preventing CAUTIs" (as an exemplar) to examine outcomes associated with e-learning programs for hospital nurses. The Kirkpatrick theory (1994) was chosen for this study because of its widespread use in the CE literature and its multi-step approach to program evaluation. The literature review in chapter 2 will

present and critique the literature that describes the hypothesized relationships depicted in the theoretical framework used to guide this dissertation study.

Chapter 2: Literature Review

The focus of this dissertation study was to evaluate an existing e-learning program, "Preventing Catheter Associated Urinary Tract Infections (CAUTIs)" for hospital based nurses utilizing the Kirkpatrick theory (1994). This chapter presents a synthesis and critique of the literature related to the relationships between constructs that were central to the focus of this study. This chapter will begin with a discussion of literature regarding participant reaction to e-learning experiences. This discussion is followed by research on factors that contribute to learning that occurs as a result of e-learning experiences. Next, research on changes in nurses' behaviors as a result of participating in e-learning programs, are discussed. Fourth, a discussion of the literature on the expected results following e-learning experiences is presented. Finally, a summary of the state of the science as is evident in the literature is presented along with an identification of the critical gaps in this literature. The chapter summary concludes with a discussion of how this dissertation research attempted to address specific empirical gaps identified.

First, an examination of the continuing education (CE) literature was conducted and is presented below. One of the articles is dated, however it provides important information related to the evolution of CE. From the Proceedings of the National Conference on Continuing Education in Nursing (Cooper, 1971), there is a discussion of the lack of consistent and expansive research related to CE (Cooper, 1971). This is still the current state of the field and with many technological advances in CE there is a much wider gap in the current CE research. Ironically, the emergence of a high need for CE came from the high volume of research conducted in universities which led to continual advancements and a need to educate professionals on the research developments in their

21

fields (Cooper, 1971). This increase in research has no longer made it possible to graduate from college and have all of the knowledge needed for one's entire career (Cooper, 1971; Kohl & LaPidus, 2000). Instead, lifelong learning is needed to stay current. As research continues to expand in all fields including healthcare, so does the need for CE. CE is the means that healthcare professionals receive updates on the changes and breakthroughs that impact their practice (Cooper, 1971; Kohl & LaPidus, 2000). This is especially meaningful for nurses due to the push for more evidenced based practice that may enhance patient safety.

CE is impacted by several current trends. A group of regional colleges and public institutions across the United States (U.S.) decided to conduct research to identify emerging or future trends that impact CE (Glessner, 2011). The trends identified were the: expanding use of e-learning, changing ethnic /cultural landscape, fast paced and rapid changes in my professions, need to change jobs/careers more frequently than previous generations, and need for continuous, lifelong learning. All of these emerging trends create an elevated need for high quality CE (Glessner, 2011).

The major types of CE programs currently offered are: classes, workshops, conferences, lecture series, correspondence courses, and e-learning (Zaghab, Maldonado, Whitehead, Bartlett, & Rodriguez de Bittner, 2015). Currently, the most common method for CE for hospital nurses is onsite classroom based programs (Zaghab et al., 2015). One common informal way of learning in the workplace is when workers observe their peers and engage in communication with their coworkers while on the job (Choy, Billett, & Kelly, 2013). In one Australian study by Choy et al. (2013), learners were surveyed regarding their learning preferences. The results were that they preferred direct teaching in a group and working /sharing with peers. Additionally, workers are very concerned

with time commitment. They want to commit only the necessary time required to complete a program and be able to they see outcomes as a result of their efforts and time investment (Choy et al., 2013).

The growing market for CE has expanded access and program availability (Cantor, 2006). CE is frequently required for maintenance of licensing, professional certifications, employment, and lifelong learning (Cantor, 2006). CE is undergoing changes to diversify methods that adapt to the needs of learners and their rapidly evolving workplaces and roles. The aging workforce and nontraditional students create a wide and varied learner with different CE needs and preferences (Cantor, 2006; Hoyt & Whyte, 2011). However, face to face CE programs are still the dominate format. Conferences and seminars are other methods for obtaining CE. Selection of CE format is based on perceived value, program satisfaction, time investment, cost, and quality of the presentation and facility (Hoyt & Whyte, 2011). E-learning is one method for obtaining CE that is increasing in prevalence (Hoyt & Whyte, 2011).

REACTION (STEP ONE)

"Reaction is how those who participate in the e-learning program respond to the program and their reactions indicate how well participants liked the program" (Kirkpatrick, 1994, p. 21). Reaction to a program could be positive or negative and can affect the second step of the theory, learning (Kirkpatrick, 1994). Several e-learning studies that examined the concept of reaction are presented.

Atack and Rankin (2002) conducted a descriptive study with 43 registered nurses (RNs) based on Lawton's Model of distance education theory (Atack & Rankin, 2002). The researchers sought nurses' feedback regarding a 16 week e-learning, post diploma course, Health Care Relationships. Researchers used an investigator developed tool

(Online Learner Support Instrument) to assess participant reactions to the program. They found that 96% of the RNs enjoyed the convenience of the e-learning since they could access it from home or work. All of the RNs that completed the study indicated that they would participate in another e-learning course in the future. 82% of the participants felt that the e-learning course met their learning needs. 79% of the participants expressed satisfaction with interactions with peers and faculty. 42% of the participants wanted more interaction with peers and 43% wanted more instructor feedback (Atack & Rankin, 2002).

In addition to this quantitative assessment, Atack (2003) conducted focus groups with a different group of 20 nurses to describe the nurses' experiences with the e-learning program. Concerns raised by the participants during the focus group sessions included lack of computer and internet availability and lack of time for the e-learning program at work due to the intense work load of the nurses. Conversely, the nurses responded positively regarding the convenience of the e-learning program and with the group support received in the online setting. The nurses also had positive comments about the e-learning program design and content (Atack, 2003).

Seiler and Billings, (2004) conducted a qualitative descriptive study using Billings' framework (2001) seeking to understand the nursing students' (34% MSN, 18% BSN, 34% RN-to-BSN, and 6% doctoral) experiences with e-learning programs. 458 student nurses participated. A 45 item survey (Evaluating Educational Uses of Web-based Courses in Nursing, EEUWIN) that combined fixed and open ended questions was used to measure student reactions to an e-learning program used in their academic setting. This study examined the two open ended questions using qualitative description. Researchers were interested in student reaction to technology use, educational practices,

and outcomes as related to the e-learning program. There were a total of 631 comments for the items. Technology issues received the smallest number of negative comments (33 comments). Another concern for the students was the lack of interaction and connectedness among students and faculty in e-learning programs (16 comments). Convenience and flexibility with life issues experienced with e-learning was perceived as a point of satisfaction for the majority of study participants (141 comments). No percentages were given for the data, only the number of comments was reported for each area. The researchers concluded that: satisfaction with e-learning correlates with effectiveness of educational programs and it is important to collect data on participant satisfaction with e-learning programs so that e-learning programs can be improved to provide optimal teaching-learning experiences (Seiler & Billings, 2004).

Billings, Connors, and Skiba (2001) conducted a study to determine best practices in e-learning communities for Web-based nursing courses using the seven principles of good practice in undergraduate education developed by Chickering and Gamson (1987). 219 undergraduate nursing students participated in the study. Researchers adapted the Flashlight Program Current Student Inventory (CSI) tool kit (Ehrmann & Zuniga, 1997) to assess participant responses using a 5 point scale. Billings, Connors, and Skiba (2001) found significant positive correlations between convenience and active learning ($r = .64$), feedback ($r = .34$), student-faculty interactions ($r = .54$), and interaction with peers ($r = .37$). Significant correlations ($p=.01$) were also observed between convenience and satisfaction ($r = .76$), preparation for real-world work ($r = .67$), socialization ($r = .66$), and connectedness ($r = -.54$). Overall, students were satisfied with the e-learning courses used in this study ($M = 3.2$, $SD =1.18$). Students consistently reported a lack of connection with faculty and other students in the e-learning programs. This lack of connection was

significantly negatively correlated with satisfaction (r = -.61) and socialization (r = -.50). Conversely, students reported increased socialization as a positive outcome of the e-learning in this study. Increased socialization was significantly positively correlated with active learning, (r = .57), feedback, (r = .55), student faculty interactions(r = .59) and interaction with peers (r = .34). Computer literacy improved in this study with increased use of the e-learning technology (t = 95.7, P <= .01) (Billings et al., 2001). These results suggest that satisfaction with e-learning varies in relation to socialization and lack of connection.

Patel (2007) conducted a study to evaluate participant satisfaction with 16 nurses who had just completed a graduate nursing program and then completed a post graduate critical care e-learning program. Patel found that 94% of the participants reported that they were integrating their new knowledge into practice, 68.8% found the e-learning program was easy to navigate, and 81.3% of the participants were satisfied with the technical aspects of the e-learning program. The effect size for the relationship between stimulating e-learning program content and preference to learn with e-learning was 0.667, which was significant at p=.01 in this small sample (Patel, 2007).

Sheen and colleagues (2008) conducted a study to evaluate the effectiveness of an e-learning program to assist hospital nurses with the learning of intensive care skills as compared to a traditional classroom program. 42 hospital nurses participated in the study, 22 were randomly assigned to the e-learning program and 20 nurses received the traditional classroom program. Five courses were included, they were: case study, career development, teaching and learning, nursing and law, and communication. The same five instructors that presented the traditional classroom content also developed the e-learning program to ensure consistency. Evaluation of reaction consisted of collecting nurse

attitudes about the five courses during post course group meetings. Questions were asked to elicit feedback about program satisfaction, pros and cons of the program, and any suggested changes to the program. The majority of nurses described positive learning experiences. 41 nurses were satisfied with the programs. Participants cited the benefits of e-learning are convenience and time savings. The e-learning group wanted more instructor interaction. Participants in the traditional classroom group were frustrated with the location of the classes and lack of flexibility with time management. This group enjoyed the interactions with instructors. The majority of the nurses in both groups liked the program and felt that the program objectives were met (Sheen, Chang, Chen, Chao, & Tseng, 2008).

Spiva, Johnson, Robertson, Barrett, Jarrell, Hunter, & Mendoza (2012) conducted a study that was guided by adult learning theory (Knowles, 1980) and McClesky's (2009) four strategies for e-learning design. The study evaluated the effectiveness of an electrocardiogram (EKG) e-learning program as compared to an instructor lead group on knowledge of interpretation of EKG rhythm strips accurately and confidence in EKG interpretation. The e-learning program used was," Learn Rhythm Adult", created by the American Heart Association and Healthstream (2012). 135 hospital nurses completed the study. An investigator developed confidence scale and an 11 item course evaluation (1=strongly disagree and 5= strongly agree) were used. There were five groups: traditional classroom (n=33), e-learning group without study time (n=13), e-learning group with one week of study time (n=13), e-learning group with two hour post course instructor facilitated debriefing and no study time (n=13), and e-learning group with two hour post course instructor facilitated debriefing and one week of study time (n=63). Course evaluations contained equal levels of satisfaction for all five groups. Traditional

27

classroom (mean=4.46), e-learning group without study time (mean=3.81), e-learning group with one week of study time (mean=4.52), e-learning group with two hour post course instructor facilitated debriefing and no study time (mean=4.01), e-learning group with two hour post course instructor facilitated debriefing and one week of study time (mean=4.23). Overall, nurses felt the programs were useful and met their needs (Spiva et al., 2012).

Morgan and Casper (2000) developed taxonomy of participant reactions to training programs. They focused on reaction (level one) and created a database of participant reactions (from 9,128 employees of a government agency) to programs and explored the reactions in depth. The rationale is that participant reactions to a program are the most frequently used means to evaluate programs and need to be better understood to more effectively evaluate programs. Reaction can be used to improve program design and delivery. Reaction supports participants so that they know their opinions matter and are heard. Further, reaction may be a predictor of higher levels within the theory (learning, behavior, results). A factor analysis using the participant reaction forms collected and a reaction form developed by the researchers was conducted. The results found that participant reaction (step one) to a program is multidimensional and has a relationship to learning and behavior change. Inadequate acknowledgement of the multiple dimensions of participant reactions may impact the higher steps of the theory. The authors found that one key piece of participant reaction is related to the instructor in that reaction has a high correlation with satisfaction with the instructor (Morgan & Casper, 2000).

An e-learning program, Tobacco and Public Health: From Theory to Practice developed by the Canadian government was evaluated in a study with 59 public health

professional participants. A modified Kirkpatrick theory was used in this study. Reaction was evaluated with a researcher developed survey. The results of the survey found that 97% of the participants would recommend the e-learning program to others and 98% of the participants thought the program was a good time investment (Sears, Cohen, & Drope, 2008).

A Taiwanese study evaluated a breastfeeding program using Kirkpatrick's theory. The intervention group had 46 pregnant women that received a group education program on breastfeeding. There were also 46 pregnant women in the control group that did not receive an educational program but received usual prenatal care. Satisfaction with the program was measured via researcher developed questionnaires. This satisfaction scale used a seven-point Likert scale with scores from 1–7. The satisfaction scores in the intervention group ranged from 5.9 (duration of the course) to 6.5 (knowledge gained from the course) on the items. The intervention group had higher breastfeeding satisfaction at three days and one month postpartum (Lin, Chien, Tai, & Lee, 2008).

One study reviewed the literature that used the Kirkpatrick's theory (1994) in inter-professional continuing education (IPE) and reviewed the evaluation instruments. It sought to categorize the percentage of instruments used in each of the 4 steps of the theory. 163 articles were reviewed with 33 evaluation tools. Of these, 20.6% assessed learner reactions (Gillian, Lovrics, Halpern, Wiljer, & Harnett, 2011).

McMullan, Jones, and Lea (2011) conducted a study to compare an e-learning program on drug calculations developed using Cognitive Load Theory (Sweller, 1988) with a handout on drug calculations. Participants were 98 (58 e-learning, 40 control group) second year diploma nursing students. Participants were given a satisfaction scale after completion of the e-learning program or control group handouts. Students in the e-

learning group were more satisfied than the students who used the handout (p = 0.001). The e-learning participants scored higher in satisfaction with enhancement of learning (p = 0.023), effectiveness of the learning program (p = 0.005), opportunity for practice and feedback (p < 0.001), accessibility (p = 0.027), ease of use (p = 0.02) and enjoyment (p = 0.022).

Satisfaction with an e-learning program, an annual kidney transplant competency course, was evaluated. The theories used for the e-learning program course development and implementation were Constructivist Learning Theory (Moallem, 2001) and Adult Learning Theory (Knowles, 1980). 20 hospital based kidney transplant nurses completed the study. A Likert type course evaluation was used to evaluate the e-learning program. 100% of the nurses were satisfied with the program, rating it as very good or above average (Gerkin, Taylor, & Weatherby, 2009).

Patterson, Krouse, and Roy (2012) conducted an integrative review (1999 to 2009) to describe the nursing research on student outcomes of distance learning using Astin's input-environment-output conceptual (I-E-O) model (1993). 33 studies were reviewed with 66% measuring reaction. The study participants were nursing students in: associate, bachelors of science in nursing (BSN), registered nurse (RN) to BSN, masters, and doctorate programs. Sample sizes were mostly convenience and female with sizes that ranged from 28 to 1149. Most of the researchers reported that students were satisfied with e-learning programs. Some researchers compared e-learning program satisfaction to traditional face-to-face programs and found no differences in satisfaction. The integrative review findings were that: most studies did not have a theoretical framework and this is needed to guide research questions and variables of interest (Patterson et al., 2012).

Based on the literature presented, existing research provides support for the hypothesis that nurses, nursing students, and other healthcare providers participating in e-learning programs describe their experiences with e-learning programs as enjoyable and that the programs facilitated their learning (Atack et al , 2002; Atack, 2003; Billings et al, 2001; Gerkin et al., 2009; Lin, et al., 2008; McMullan et al., 2011; Morgan et al., 2000; Patterson et al., 2012; Sears et al., 2008; Seiler & Billings, 2004; Sheen et al., 2008; Spiva et al., 2012). Many of the nurses and nursing students reported that the e-learning programs offered greater convenience and availability as compared to traditional classroom based programs. However, nurses and/or nursing students also reported dissatisfaction with the lack of interaction with other nurses/nursing students and instructors in the e-learning environment. These studies were conducted utilizing a broad range of participants, approaches, and e-learning topics. While these differences limit the ability to compare findings, they also illustrate the versatility of e-learning across populations and topics.

Limitations noted in the e-learning evaluation literature are many. First, there are few theoretically based studies that describe the evaluation of e-learning programs for hospital nurses. Of those few studies that do provide a theoretical background for obtaining nurses' reactions to programs, there is no consistency across studies as to which theoretical framework is best to guide this evaluation. This lack of theoretical consistency results in a wide variation in approaches used to obtain participant reactions to e-learning programs. Also there is a lack of reported quality (reliability and validity) of the tools used and there is wide variability in the way that reaction is measured.

None of the studies conducted to evaluate participant reactions in e-learning programs for hospital nurses used the Kirkpatrick theory (1994). This theory offers the

potential for a more comprehensive understanding of the overall effectiveness of an e-learning program by linking participant reactions to learning. Learning is the next concept in the Kirkpatrick theory (1994) that guides this study. The literature exploring this concept will now be discussed.

LEARNING (STEP TWO)

Reaction to a program could be positive or negative and will affect learning (step two). "The concept of learning is defined as the extent to which participants change attitudes, improve knowledge or confidence, and/or increase skills, as a result of completing the program" (Kirkpatrick, 1994, p.22). One example of measurement of learning is the use of pre and post testing to evaluate knowledge acquisition (Kirkpatrick, 1994).

The impact of a Finnish e-learning program (already developed), ePsychnurse.net, on nurses' knowledge of physical restraint, seclusion, and coercion legislation, attitude towards physical restraint and seclusion, job satisfaction, and self-efficacy was performed. The e-learning program was designed using the theory of reflective learning; however no theory was mentioned for this study which evaluated this already developed e-learning program. The study was a randomized control trial (RCT) with a control (traditional classroom) group and intervention (e-learning) group. 158 psychiatric inpatient nurses completed the study with n= 95 in the intervention group and n= 63 in the control group. Knowledge acquisition was measured at baseline and immediately after program completion using the modified Physical Restraint Questionnaire (Janelli et al., 1992). The results were that there was improvement in knowledge of seclusion in both groups (p=0.001 for both groups). Knowledge of restraint practices remained unchanged in both groups. Knowledge of coercion legislation improved in the

32

intervention group (p=0.036).   Self-efficacy improved in the intervention group (p=0.046). "There was no noticeable effect size for any of the variables measured" (Kontio et al., 2011, p. 817).

The previously mentioned study (Patel, 2007) used the Australian Basic Intensive Care Knowledge Test (ABICKT) (1994) to evaluate the effectiveness of a post graduate critical care e-learning program. There were 16 nurse participants in this one group pre-test- post-test design study. The e-learning program, post graduate specialty practice Adult/Pediatric Critical Care nursing course, was used as part of a post graduate certificate program for nurses. Knowledge acquisition was assessed pre-course and immediately post-course completion using the Australian Basic Intensive Care Knowledge Test (ABICKT). Post-test scores improved from pre-test though the increase was not statistically significant at p<.05. No theory was mentioned in this study (Patel, 2007).

Schneidermann, Corbridge and Zerwic (2009) studied the effectiveness of an e-learning program specific to arterial blood gas (ABG) interpretation. The Sensory Stimulation Theory by Laird (2003) and Adult Learning Theory (Knowles, 1980) were used in this study to develop the ABG e-learning program. 48 hospital nurses completed this one group pre-test post-test design study. An investigator developed pre-test was given prior to the e-learning program and an identical post-test was administered immediately following the completion of the ABG e-learning program. The nurses significantly improved their ABG knowledge after completing the e-learning program (p<.001). The authors found no correlation between education levels, years of experience, or nursing specialty area and knowledge increase post e-learning program (Schneidermann et al., 2009).

33

Mctigue, D'Andrea, Doyle-Munoz, and Forrester (2009) conducted a one group pre-test post-test design study with 416 acute care hospital nurses that completed an e-learning program, Skin Tear education program. This study measured knowledge acquisition to determine if learning occurred, though there was no mention of any theory in the study itself. An investigator developed test was used to measure knowledge acquisition. Pre-test and post-testing (immediately after program completion) was conducted. There was a significant increase in knowledge from pre-test to post-test ($p<.001$) in the following areas: identification and assessment of skin tears, the Payne-Martin Classification System, and skin tear treatment (Mctigue et al., 2009).

A study conducted by Moule, Albarran, Bessant, Brownfield, and Pollock (2008), investigated whether there were any differences among mental healthcare professionals (nurse researchers, nurse managers, nurses, clinical psychologists and medical staff) in knowledge acquisition in basic life support (BLS) and automated external defibrillator (AED) use, between an e-learning group and a traditional classroom group. 55 participants were in the traditional classroom group and 28 were in the e-learning group. Comparisons of participant knowledge acquisition were made using an investigator developed multiple choice questionnaire. Statistically significant increases in knowledge acquisition were seen in both groups. Improvement in knowledge scores for each group was statistically significant (classroom, $P < 0.001$; e-learning, $P < 0.001$); although the differences in knowledge acquisition between groups was not statistically significant. There was no mention of theory in this study (Moule et al., 2008).

Sheen and colleagues (2008) conducted a study to evaluate the effectiveness of an e-learning program to assist hospital nurses with the learning of intensive care skills as compared to a traditional classroom program. 42 hospital nurses participated in the study,

22 were randomly assigned to the e-learning program and 20 nurses received the traditional classroom program. 5 courses were included, they were: case study, career development, teaching and learning, nursing and law, and communication. The same five instructors that presented the traditional classroom content also developed the e-learning program to ensure consistency. Then each participant had a skills test with: intravenous (IV) injection, intramuscular (IM) injection, insulin injection, blood transfusion administration, Foley catheter insertion/removal, and enema administration. The skill test was scored as pass or fail. All nurses in both groups passed the skills exam (Sheen et al., 2008).

In the previously mentioned study by Spiva et al. (2012), investigators evaluated the effectiveness of an electrocardiogram (EKG) e-learning program as compared to an instructor lead group on knowledge of accurate interpretation of EKG rhythm strips. The e-learning program used was," Learn Rhythm Adult", created by the American Heart Association and Healthstream (2012). 135 hospital nurses completed the study. An investigator developed knowledge test was utilized to measure learning of accurate EKG rhythm interpretation pre and post-test (immediately after program completion). Significant ($p=.00$) increases in knowledge of accurate EKG interpretation were present for the instructor led and e-learning groups from pre-test to post-test. Additionally, participant's confidence in EKG interpretation increased significantly ($p=.00$) in all groups except the e-learning group without study time (Spiva et al., 2012). The study mentions that it is important to include principles of Adult Learning Theory (Knowles, 1980) to design an effective educational program, however the study does not present any theory used for this study.

The effectiveness of an e-learning program, an annual kidney transplant competency course was evaluated by Gerkin et al. (2009) in a one group, post-test only study. The theories used for the e-learning program course development and implementation were Constructivist Learning Theory (Moallem, 2001) and Adult Learning Theory (Knowles, 1980). 20 hospital based kidney transplant nurses completed the study. An investigator developed knowledge post-test was used to evaluate the e-learning program. The average post-test score was 94.8%; all of the nurses passed the post-test. 87.5% of the nurses found that the e-learning program was helpful in enhancing patient care and that the e-learning format enhanced learning (Gerkin et al., 2009).

Garrison & Schardt (2007) compared an e-learning program for medical librarian to a traditional classroom program; both programs taught the participants to advocate for evidenced based medicine. 72 librarians completed the study. Tests of learning were administered: pre-class, post-class, and six-months post-class. The results found that scores increased from pre-class to post-class (classroom increased by 57%, e-learning increased by 21%). The e-learning group averaged 10 points higher than the class group on the pre-test. The test scores declined from post-test to six month post-test (classroom group decreased by 14%, e-learning decreased by 11%). The differences in knowledge acquisition and knowledge retention between the groups were not statistically significant. 61% of the e-learning group participants preferred the e-learning environment. Participants in both groups cited the following about benefits of e-learning: convenience, no travel required, updated information, and ability to work at own pace (Garrison & Schardt, 2007).

An e-learning program, prevention of venous thromboembolism (VTE) was evaluated using a two group pre-test post-test design (Wolpin, Lee, Glenny, Wittkowsky,

Wolf, & Zierler, 2011). 69 physicians completed the study. The participants were assigned to an e-learning program with static screens (control group) or an e-learning group with interactive screens and case studies. Participants were satisfied with both e-learning programs and felt that they were helpful, Pre-test and post-tests were administered to both groups. There was a knowledge increase in both groups from pre-test to post-test however it was not statistically significant. Further, the effect size for this relationship was 0.23. There was no statistically significant difference in knowledge gain between the two groups. No theory was mentioned in this research study (Wolpin, et al., 2011).

A study by Hart, Eaton, Buckner, Morrow, Barrett, Fraser, and Sharrer (2008) evaluated the effectiveness of an evidenced based practice and research utilization e-learning program on nurses' perceptions of knowledge, attitude, and skill level. The design was a one group pre-survey and post-survey (two weeks after program completion). 314 hospital nurses completed the study. The results showed statistically significant differences in the post intervention survey regarding: perceptions of knowledge (p = .022), attitude (p < .001), and skill level (p < .001), and beliefs about organizational readiness, (p < .001). No theory was described in the study (Hart et al., 2008).

In the previously mentioned study of the e-learning program, Tobacco and Public Health: From Theory to Practice with 59 public health professionals (Sears et al., 2008). A modified Kirkpatrick model was used in this study. Learning was evaluated with a knowledge test administered at 3 time points, preprogram (time point 1), immediately after program completion (time point 2), and 2 months after program completion (time point 3). Knowledge gains occurred between time points 1 and 2 (p < 0.001). At time

point 3, scores were higher than time point 1 (p<.001), however there was a decrease in knowledge scores between time points 2 and 3 (p<.001) (Sears et al., 2008).

A Taiwanese study by Lin et al. (2008) evaluated a breastfeeding program using Kirkpatrick's theory. Breastfeeding knowledge and attitude was measured via self-report questionnaire pre-intervention, post intervention, three days postpartum and one month postpartum. There were no significant differences between the groups in mean attitude scores at any of the time points. The experimental group had significantly higher (p=.001) breast feeding knowledge and attitude scores at 3 days and one month postpartum (Lin et al., 2008).

McMullan, Jones, and Lea (2011) conducted a RCT to compare an e-learning program on drug calculations developed using Cognitive Load Theory (Sweller, 1988) to a control group using a handout on drug calculations. The sample was second year diploma nursing students with 58 in the e-learning group and 40 in the control group. Drug calculation ability and self-efficacy tests were given to the participants pre- and post-intervention. A 20 question investigator developed drug calculation ability test was used to measure learning. Also, a self-efficacy test was used to evaluate students' confidence in calculating drug doses. Students in the e-learning group scored better on drug calculations test than those receiving the handout (p = 0.027). Students in the e-learning group had higher self-efficacy in doing drug calculations than students in the control group (using handouts) (p = 0.022) (McMullan et al., 2011).

Jeffries (2001) conducted a study to evaluate BSN student learning of oral medication administration concepts through an e-learning program (CD-ROM developed program) compared with an equivalent lecture course using the Principles of Best Practices in Education (Chickering & Ehrmann, 1996). This study compared differences

in students' cognitive learning, related to medication administration using a pre-test post-test design. Forty-two junior baccalaureate nursing students completed the study with 23 students randomly assigned to the intervention group and 19 randomly assigned to the comparison group. The e-learning (CD ROM) group had significantly (p = .01) higher post-test scores than the lecture group. There was no difference in pre-test scores between the groups (Jeffries, 2001).

One study reviewed the frequency of use of Kirkpatrick's theory (1994) in inter-professional continuing education (IPE) evaluation instruments. 163 articles were reviewed with 33 evaluation tools obtained. 68% of the instruments assessed changes in perceptions of learning (Gillian et al., 2011). No additional details were provided by this study.

Sheen and colleagues (2008) conducted a study to evaluate the effectiveness of an e-learning program to assist hospital nurses with the learning of intensive care skills as compared to a traditional classroom program. 42 hospital nurses participated in the study, 22 were randomly assigned to the e-learning program and 20 nurses received the traditional classroom program. 5 courses were included, they were: case study, career development, teaching and learning, nursing and law, and communication. The same five instructors that presented the traditional classroom content also developed the e-learning program to ensure consistency. After each course of the program was completed, each participant took a 10 item multiple choice exam related to that content area. Both groups had similar knowledge scores on the exams. Only the teaching and learning and communication courses had higher post-test scores in the traditional classroom group. All other score differences were not significant at p<.05 (Sheen et al., 2008).

A literature review by Lewis, Davies, Jenkins, and Tait (2001) of academic nursing education was performed to investigate methods used in evaluating e-learning programs used. There was no mention of theory used for the literature review; however they chose guidelines for evaluation of the studies' findings that are similar to the Kirkpatrick theory. The categories used for organizing the studies' findings were: satisfaction with the program, cognitive recall, transfer of learning, objectives met, and attitudes toward e-learning. The results found that many of the studies were: qualitative or anecdotal, subjective accounts by the researchers. Few of the studies were well executed or quantitative in design. The superior studies in the review had the following components: cognitive recall post e-learning, application of the knowledge gained using e-learning, and knowledge retention. The conclusions of the literature review were that few of the studies investigated application of knowledge post e-learning program completion or knowledge retention beyond that assessed immediately post e-learning program (Lewis et al., 2001).

Patterson, Krouse, and Roy (2012) conducted an integrative review (1999 to 2009) to describe the nursing research on student outcomes of distance learning using Astin's input-environment-output conceptual (I-E-O) model (1993). 33 studies were reviewed with 66% reporting no theoretical framework. The study participants were nursing students in: associate, bachelors of science in nursing (BSN), RN to BSN, masters, and doctorate programs. The majorities of the studies were quantitative and evaluated cognitive outcomes. Sample sizes were mostly convenience and female with sizes that ranged from 28 to 1149. The review found that in the majority of the studies there were no significant differences in post-test scores for students in e-learning

programs versus the same course in a traditional face-to-face classroom program (Patterson et al., 2012).

Some of the studies found that e-learning programs encouraged independence and self-direction in learners. In three studies, students in e-learning programs reported improved confidence, increased determination, and enthusiasm. In one study students in e-learning reported increased self-efficacy. The integrative review findings were that: most studies did not have a theoretical framework and this is needed to guide research questions and variables of interest. Further, it is tenuous to state that nursing student outcomes of e-learning programs versus face-to-face courses are equivalent or comparable to e-learning program for hospital nurses because of significant differences in samples, methodology, and lack of theoretical frameworks. There is a need for reliable and valid evidence of outcomes of e-learning for hospital nurses to determine its effectiveness.

The most common research design found in the literature was a one group pre-test post-test design. The most prevalent method of evaluation was a post-test focused on the cognitive knowledge domain. The majority of the one group pre-test post-test studies showed statistically significant increases in knowledge. The evidence suggests that e-learning programs may be as effective as traditional classroom based programs for short term knowledge acquisition (Alemagno et al., 2010; Gerkin et al., 2009; Hart et al., 2008; Kontio, et al., 2011; McTigue, et al., 2009; Moule et al., 2008; Patel, 2007; Schneidermann et al., 2009; Spiva et al., 2012; Straight, 2008). The Patel (2007) study was the only study that did not have a statistically significant increase in knowledge acquisition post-test scores. One study used an evaluation of nurse self-report of knowledge acquisition (Hart et al., 2008). In 2010, the Institute of Medicine (IOM)

41

recommended that continuing education programs not be evaluated using self-report as the sole measure of program effectiveness as this is too limiting and does not provide adequate data for decision making. The IOM (2010) recommended that the CE programs be evaluated using tests of knowledge acquisition.

If e-learning is equivalent to traditional classroom based approaches for short term knowledge acquisition, then the increasing prevalence of e-learning programs may be supported by these results. Although e-learning may not be superior to traditional classroom based learning, it may be an effective, convenient alternative.

Only two studies evaluated knowledge acquisition beyond that immediately after e-learning program completion. Sears et al. (2008) used a post test at 2 months post e-learning program for healthcare providers not nurses. Hart et al. (2008) used self-reported knowledge acquisition at 2 weeks after e-learning program completion. All of the other studies evaluated knowledge acquisition immediately after e-learning program completion. This leaves little data on e-learning program impacts on knowledge retention beyond that immediately after program completion. It is important to measure knowledge acquisition beyond that immediately post e-learning program completion because many e-learning programs for nurses are designed to provide annual training for nurses. If this knowledge is not retained, this impacts nursing care and patient outcomes. This is a gap in the literature that will be addressed by this proposed study, because knowledge retention as measured by knowledge post-test has not been evaluated in hospital nurses utilizing e-learning programs.

Research on e-learning program evaluation for this population, hospital based nurses, is sparse especially theoretically based research. Few of the studies reviewed provide any theoretical basis for their research (Jeffries, 2001; Lin et al., 2008). The

studies that do mention theory do not provide a thorough theoretically based study design for evaluation. Instead, these studies mention theory and do not have theoretically guided variables, concepts, or research questions. Some of the studies discuss theory related to the design of the e-learning program but do not have a theoretically based evaluation plan (Gerkin et al., 2009; Kontio et al., 2011; 2008; Schneidermann et al., 2009; Spiva et al., 2012). This proposed study will address this gap in the literature by conducting a theoretically based study that uses a multistep approach with the Kirkpatrick theory (1994) to evaluate e-learning programs for hospital nurses. A solid theoretically based approach is needed so that study designs do not omit important aspects of e-learning program evaluation such as impacts on nurse behavior.

BEHAVIOR (STEP THREE)

Behavior is included in the Kirkpatrick theory (1994) as step three and is defined as, "the extent to which a change in actions has occurred as a result of the participant completing the educational program" (Kirkpatrick, 1994, p. 22). Behavior has been evaluated in few studies.

In a previously mentioned study of the e-learning program, Tobacco and Public Health: From Theory to Practice with 59 public health professionals (Sears et al., 2008). Practice change and perceived value of the e-learning program was evaluated with a survey. 93% of the participants found the e-learning program topic were useful in their work. 53% stated that they used the e-learning program in practice as a learning and reference tool (Sears et al., 2008).

A Taiwanese study by Lin et al. (2008) evaluated a breastfeeding program using Kirkpatrick's theory (1994). Breastfeeding problems and satisfaction with breastfeeding were measured for step three (behavior). There were no significant differences between

groups in breastfeeding problems. There was a significant difference between groups for satisfaction with breastfeeding at the one month postpartum (p=.003). The satisfaction with breastfeeding was higher in the intervention group (Lin et al., 2008).

Smeekens, Broekhuijsen-van Henten, Sittig, Russel,Turner, ten Cate, and van de Putte (2011) conducted a randomized control trial (RCT) where they evaluated the effectiveness of an e-learning program for the recognition of child abuse. Participants were emergency department (ED) nurses. 12 nurses were in the control group and 13 in the e-learning group. Participants were evaluated pre and post e-learning on their performance during a case-simulation. Self-efficacy related to performance was also evaluated pre and post e-learning. The performance on case simulation improved in both groups but the increases were not statistically significant. The increases in case simulation performance were higher in the intervention (e-learning) group. Increases in self-efficacy were seen in both groups and were statistically significant (p<.05). The results from this study support the wider use of e-learning programs to improve the recognition of child abuse by ED nurses (Smeekens et al., 2001).

Straight (2008) completed a study to evaluate the effectiveness of an e-learning program designed to provide education regarding safe medication delivery and the Lexicomp feature of the pyxis RN medstation 2000 automated medication delivery unit (AMDU). The e-learning program consisted of 29 interactive screens. 36 hospital nurses {RNs and licensed practical nurses (LPNs)} completed the study. Self-reported use of the electronic medication information resources was the measure of behavior change. Self-reported use of the electronic medication information resources by LPNs increased by 80% at one week post e-learning and 100% at one month post e-learning. For the RNs in the study, self-reported usage of the electronic medication information resources

increased by 23% at one week post e-learning and 56% one month post e-learning. No theory was mentioned in this study (Straight, 2008).

Jeffries (2001) conducted a study to evaluate baccalaureate nursing students learning of oral medication administration concepts through an e-learning program (CD-ROM developed program) compared with an equivalent lecture course using the Principles of Best Practices in Education (Chickering & Ehrmann, 1996). This study compared differences in skills in performing medication administration. Forty-two junior baccalaureate nursing students completed the study with 23 students randomly assigned to the intervention group and 19 randomly assigned to the control group. Medication administration was evaluated by the student's regular instructor in the learning laboratory. There were no significant differences between the groups on their competency in administering oral medications. There was 31% less time required for the e-learning group to complete medication administration and it was as effective in teaching nursing students oral medication administration skills (Jeffries, 2001).

In the previously mentioned Finnish RCT utilizing the e-learning program (already developed), ePsychnurse.net, nurses' attitude towards physical restraint and seclusion was measured (Kontio, et al., 2011). 158 psychiatric inpatient nurses completed the study with 95 in the intervention group and 63 in the control group. Though the study did not use the Kirkpatrick theory for its design, it did mention it as it relates to behavior (step 3) using the measurement of attitude change for behavior in this study. Attitude was measured with the Physical Restraint Questionnaire on attitudes (Janelli et al., 1992). Attitude towards seclusion and restraints was measured pre and post intervention. The only between group difference that was statistically significant was attitude toward seclusion which improved in the control group (p=0.001) (Kontio, et al., 2011).

In another study Moule et al. (2008) investigated whether there were any differences among mental healthcare professionals (nurse researchers, nurse managers, nurses, clinical psychologists and medical staff) in skill performance of basic life support (BLS) and automated external defibrillator (AED) use, between an e-learning group and a traditional classroom group. 55 participants were in the traditional classroom group and 28 were in the e-learning group. Comparisons of performance in BLS resuscitation were made. No baseline performance data was obtained. 13 skills were evaluated for each group. They were: number of ventilations performed with no errors, proportion of ventilations performed with no errors, number of ventilations with adequate volume, absolute numbers of each type of ventilation error (insufficient volume, excessive volume, inflation time, airways closed), average ventilation volume, ventilation ratio, number of compressions performed with no errors, proportion of compressions performed with no errors, compression ratio, absolute number of compressions with incorrect hand position, absolute number of compressions with incorrect release, average number of compressions per minute, and average compression rate per minute. There were no differences found between the traditional classroom group and the e-learning group with basic resuscitation skills or in the time taken to initiate the first AED shock. There was a statistically significant difference (p=.001) between groups on absolute number of compressions with incorrect release, the classroom group performed better. The classroom group also performed better than the e-learning group on the compression ratio (p=.048) (Moule et al., 2008).

One study conducted a literature review of the use of the Kirkpatrick's theory (1994) in inter-professional continuing education (IPE) (Gillian, Lovrics, Halpern, Wiljer, & Harnett, 2011). It reviewed 163 articles with 33 evaluation tools of these only

9.7% assessed changes in behavior (step three). It concluded that evaluations that included step three of the theory were sparse. Studies that did include evaluation of behavior used tools that were subjective. The reviewers concluded that objective measures (not self-report) of Kirkpatrick's theory (1994) are needed at the higher levels of the theory (step three). It did conclude that due to the complexity of CE across disciplines that a single tool for evaluation is not feasible, so multiple instruments may be needed to fully conduct evaluation using the Kirkpatrick theory (1994) (Gillian et al., 2011).

Behavior change in e-learning programs when compared to traditional classroom programs was found to be equivalent. In one study Moule et al., (2008) found that some skills were performed better in the traditional classroom group when compared to an e-learning group. There are few studies that have evaluated behavior in relation to e-learning programs. Even fewer studies have evaluated behavior in e-learning programs for hospital nurses. This proposed study will address this gap in the literature by using the Kirkpatrick theory (1994) to evaluate behavior in e-learning programs for hospital nurses.

RESULTS (STEP FOUR)

Few studies have evaluated behavior (step three) and even fewer have evaluated results (step four). "Results, are defined as the final outcome that occurred because the participants completed the program" (Kirkpatrick, 1994, p. 25). Results could be operationalized as cost, productivity, quality, sales, employee turnover, patient outcome, or job satisfaction (Kirkpatrick, 1994). Few studies evaluate this step of the theory because it is more difficult to collect this data and relate it to the e-learning program because there are other factors that may affect results (Kirkpatrick, 1994).

47

In a previously discussed Taiwanese study that evaluated a breastfeeding program using Kirkpatrick's theory (1994) the rate of exclusive breastfeeding was measured. Rate of exclusive breastfeeding was higher in the intervention group at three days and one month postpartum, though not statistically significantly different (Lin et al., 2008).

Straight (2008) completed a study to evaluate the effectiveness of an e-learning program designed to provide education regarding safe medication delivery and the Lexicomp feature of the pyxis RN medstation 2000 automated medication delivery unit (AMDU). The e-learning program consisted of 29 interactive screens. 36 hospital nurses completed the study. In the study, quarterly reports of percentage of medication errors during administration were done before and after the completion of the e-learning program. One month after the e-learning program completion, there was a 40.8% decrease in administrative medication errors in one of the facilities used in the study and a 21.5% decrease at the other facility used in the study. This study met its ultimate outcome to have safer medication delivery practice as measured by a decrease in medication errors (Straight, 2008).

A systematic review of randomized controlled studies of e-learning in nursing was conducted by Du, Liu, Liu, Yin, Xu, Zhang, and Wang (2013) for nursing students and employed nurses. This systematic review identified nine studies that met the inclusion criteria. The following research questions were addressed: is e-learning effective in increasing knowledge learning, in improving skills performance and in increasing professional growth? The results of the systematic review were that e-learning has equivalent or better impact on knowledge acquisition when compared to traditional classroom based programs. Regarding skill performance, 8 of the studies had a positive impact while one study did not. Further, this review found that participants in e-learning

48

programs have high satisfaction rates. Two of the studies reported that self-efficacy in nursing skills improved more in the e-learning group than in the traditional classroom group (Du et al., 2013).

Gillian et al. (2011) conducted a literature review of the use of the Kirkpatrick's theory (1994) in inter-professional continuing education (IPE). It concluded that evaluations that included of step four of the theory were nonexistent and found no instruments evaluated patient benefits in this literature review. The reviewers concluded that objective measures of Kirkpatrick's theory (1994) are needed at step four of the theory (Gillian et al., 2011).

KNOWLEDGE RETENTION

There is a lack of evaluation of knowledge retention beyond immediate post program evaluation. There is no discussion of knowledge retention after e-learning programs for hospital nurses in the literature. There is some discussion of knowledge retention in other disciplines and some of this is related to CE while others are related to academic courses. Ishkawa (2013) studied retention of spatial knowledge and found that it decreases quickly in the initial two weeks, but was not forgotten at 3 months. The conclusions were: there is little research in the area of knowledge retention and different types of knowledge have different rates of retention.

Cohen, Conway, and Stanhope (1992) discuss that the most rapid rate of forgetting occurs in the first 2 years after learning occurs. Additionally, memory for details and facts declines more rapidly than knowledge of general concepts and ideas. It is important for education programs to be able to estimate how long knowledge will be retained so that future programs can be planned accordingly. After about 3 months, recall of missing names and concepts was approximately 58%. The authors suggest that

knowledge retention may increase with increased learner interest and the use of knowledge in practice (Cohen et al., 1992).

In a study by Schardt, Garrison, and Kochi (2002), knowledge level was measured in medical librarians that participated in an online course or a face to face (classroom) CE course. The face to face group had 6 participants and the distance education group had 6 participants. Six months after the education program was completed, the online group had 80% of the answers correct and the classroom group had 40% of the answers correct. The authors speculated that online education may support greater self-motivation and individual practice that may impact knowledge retention rates. Further, the authors discuss the value of CE evaluation that is focused on knowledge retention (Schardt et al., 2002).

Sears et al. (2008) measured knowledge retention after an e-learning program, Tobacco and Public Health: From Theory to Practice. Healthcare providers (no nurses were listed in the demographics) had knowledge retention measured approximately 2 months after completing the e-learning program. The result found statistically significant knowledge decreases at 2 months, though the knowledge increases between pre-test and post-test (2 months) was statistically significant.

Hamilton (2005) conducted a literature review of nurses' knowledge and skill retention after cardiopulmonary resuscitation (CPR) programs. The findings were that: skills decreased faster (as few as 2 weeks) than knowledge. Knowledge and skills were found to decrease from 3-6 months after program completion so the recommendation for CPR to be taught every 3-6 months was made.

Larsen, Butler, Aung, Corboy, Friedman, and Sperling (2015) studied memory retrieval and its effect on long-term knowledge retention because memory retrieval may

strengthen memory. The authors conducted a study that looked at increasing knowledge retention after a CE program for physicians using no intervention (control group) or repeated exposure that consisted of repeated quizzing or repeated studying. The results showed that at 5.5 months after the course was completed; repeated quizzing participants had nearly twice the knowledge retention as the repeated studying or control group (Larsen, et al., 2015).

Custers (2010) reviewed the literature of knowledge retention in basic science. Numerous studies were reviewed. The time frame for measuring retention ranged from 3 months to 4 years and the retention rates varied greatly approximately 10%-90%. The author summarized the findings as approximately two thirds to three fourths of knowledge was retained at one year with a decreases to just less than 50% in the following year. Further, based on the wide variation in knowledge retention, Custers (2010) suggested that retention may be positively impacted by application and knowledge used in practice.

Pappas (2014) discusses retention in e-learning and that learners may lose 90% of what they have learned within one month. Also, factors such as: content, learner's memory and background may all impact knowledge retention (Pappas, 2014).

These findings may support the use of e-learning for CE to continue to reinforce and build upon some pre-existing knowledge. There is no consensus on the appropriate timing of knowledge retention measurement in the literature. The time frame designated for long-term retention measurement in the literature is varied. This literature points to the type of knowledge taught in the CE, frequency of CE participation, and knowledge use in practice as factors that may influence retention and thus the choice of timing for retention measurement.

CONCLUSIONS FROM THE LITERATURE

Several conclusions may be drawn from the literature. First, most participants in e-learning programs are satisfied with their experiences. Participants describe the programs as enjoyable. The pros include convenience and flexibility. The cons described in this literature review primarily consisted of inadequate instructor interaction and peer interaction. Further, e-learning programs are equivalent to traditional classroom based programs for short term knowledge acquisition. E-learning programs show some success in improving performance and skills though the research in this area is very sparse and limited. The only study (Straight, 2008) that included results (step four) found that the e-learning had a positive impact on medication error rates.

GAPS IN THE LITERATURE

There are no studies using e-learning programs for hospital nurses to prevent CAUTIs. The literature on e-learning programs for hospital nurses is sparse and some is dated. Most of the e-learning research for nurses is completed in the academic setting with nursing students. There is a lack of theoretically based program e-learning studies that examine e-learning programs for hospital nurses. The Kirkpatrick theory (1994) has not been used in research for e-learning programs for hospital nurses. The majority of the e-learning literature uses a pre-test post-test design to evaluate knowledge acquisition immediately after e-learning program completion. There is no research on hospital nurses completing e-learning programs that evaluates knowledge acquisition using post-tests beyond the immediate completion time point. It is important to have data on knowledge retention as many e-learning programs are used to provide annual education and are expected to impact nursing practice and patient outcomes for a period of months. Another gap in the literature is there are few studies that evaluate behavior (step three) and results

52

(step four) related to e-learning programs for hospital nurses. It is important to evaluate these aspects of e-learning.

This research study addressed the following gaps identified in this literature review. There is a lack of theoretically based e-learning research that examines effectiveness for hospital nurses. The majority of the studies reviewed did not mention any theory in the study. Some of the studies mentioned theory however there was no inclusion of the theory in the study design. This study utilized theory for the entire design as it is a theory driven study. Each aspect of the study design and the research questions were based in theory. The study utilized an entirely theory driven approach to the evaluation the effectiveness of e-learning programs for hospital nurses using an exemplar e-learning program, preventing CAUTIs.

The theory used in this study is the Kirkpatrick theory (1994).This study was the first use of this theory to evaluate e-learning programs for hospital nurses. This study utilized the Kirkpatrick theory (1994) in this specific population. Further, there has not been previous research conducted for e-learning programs in this topic area, preventing CAUTIs. This study used an existing e-learning program to provide education to address CAUTIs. This study used the Kirkpatrick theory (1994) to address the lack of research on this topic and within this population.

This study addressed a gap in the literature by measuring knowledge acquisition using post-tests beyond the immediate program completion time point. This study conducted post-testing immediately after e-learning program completion and at one month after e-learning program completion. In doing this, this study attempted to address knowledge retention in hospital nurses completing the e-learning program, preventing CAUTIs.

In addition to providing data related to knowledge retention. This study evaluated another gap in the literature that is the sparse number of studies that evaluate behavior (step three) and results (step four). These steps are part of the Kirkpatrick theory (1994) and have not been evaluated in e-learning programs for hospital nurses. This study will evaluate the concepts of behavior and results using the existing e-learning program, preventing CAUTIs, for hospital nurses.

Chapter 3: Methods

In this chapter, the methods used in this study are described. This is a theory driven study that uses Kirkpatrick Theory (1994) as a guide. This chapter describes the research design, site, sample, recruitment procedures, instruments that were used to collect data, a description of the e-learning program, Preventing Catheter Associated Urinary Tract Infections (CAUTIs), whose effectiveness on influencing hospital based nurse's knowledge and behaviors was assessed, methods to ensure protection of human subjects, data collection schedule and procedures, data cleaning, and data management and analysis methods are presented.

RESEARCH DESIGN

The design was a mixed methods study that was used to determine the effectiveness (on nurse satisfaction, learning, self-reported behavior change, and CAUTI rates) of e-learning programs for hospital nurses using a theoretically based approach (Kirkpatrick, 1994) to examine the program, Preventing CAUTIs, as an exemplar. Nurse satisfaction was measured using a reaction survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). The reaction survey was administered immediately after the e-learning program. The responses were reported in aggregate form for the open ended questions and questions using a Likert type scale. A one group repeated measures design was used to compare scores on the pre-test and two post-tests measuring participant knowledge acquisition. The pre-test was administered immediately before the participants began the e-learning program. The first post-test was administered immediately following completion of the e-learning intervention [traditional timing for assessment]. The second post-test was administered at one month after completion of the e-learning intervention.

Behavior was measured by nurse self-report using a modified version of an existing Kirkpatrick tool (Kirkpatrick Partners, 2011). Rates of CAUTIs were measured to represent results. This data was reported as exact number of CAUTIs for the time period before and after the e-learning program completion. Data was compared before and after the e-learning program completion.

SITE

The study was conducted in a large metropolitan hospital in a southern state that currently uses e-learning for continuing education (CE) of their hospital based nurses. The study hospital (here after called 'the hospital') is part of a larger corporate network of United States (U.S.) hospitals. The hospital has been using e-learning programs for CE of nurses for 10 years. The hospital has a total of 210 beds with approximately 724 nurses. The medical surgical department in the hospital has 128 medical surgical beds (including an intermediate care unit) and approximately 200 medical surgical nurses, a large majority of who are registered nurses (RNs). The population for this study will be drawn from the medical surgical nurses. CAUTIs are a persistent problem in most hospital settings and continuing education for hospital based nurses is one way that the hospital is trying to lower rates/incidence of CAUTIs. In 2013, the hospital had a CAUTI rate of 2.592% as compared with the state rate of 0.531% (hospital-data.com, 2013)

SAMPLE

A convenience sample of RNs was recruited from the hospital. Inclusion criteria for the study were that participants were:

1) RNs with at least an associate degree in nursing

2) Currently employed by the institution, there was no minimum number of work

56

hours required

3) Worked in the acute care setting (medical-surgical, intermediate care)

4) Provided direct patient care on at least one of the identified units;

5) Able to speak, read, and write English.

Exclusion criteria included: there are no additional exclusion criteria

These inclusion criteria were selected because current employment with the institution allowed participants access to the learning management system (LMS) and e-learning program used in this study. Additionally, the target audience for the e-learning program, Preventing CAUTIs, was medical surgical and intermediate care nurses, thus these are the nurses that were be targeted for this study. Next, participants must have provided direct patient care on at least one of the identified units to ensure that they had opportunities to manage urinary catheters. Finally, English was the language utilized for the e-learning program (Preventing CAUTIs) and the evaluation. Therefore only those nurses who can read, write, and speak English were included in the study. Participation was voluntary and there was no compensation for participation.

According to Brink and Wood (2001) when probability sampling cannot be used and a sample size must be determined, the size of the sample is determined by the number and type of variables that will be measured. This study measured the variables: reaction, learning (3 time points), behavior, and results. Brink and Wood (2001) recommend having 5 participants per variable. Using these four variables plus 2 levels of learning yielded 30 participants needed.

Attrition was another consideration in sample size for this study. While many studies reported little to no attrition (Gerkin et al., 2009 ; Moule et al., 2008; Patel, 2007; Schneidermann et al., 2009), other studies reported attrition rates that ranged from: 19%,

to 58% (Hart et al., 2008; Kontio et al., 2011; Spiva et al., 2012; Straight, 2008;). Therefore, an additional 18 participants (58%) were recruited in order to account for possible attrition. A final minimum target sample of 48 was anticipated for this study. A power analysis was not used for sample size determination because the study is mixed methods and the power analysis is focused on the sample size necessary for the repeated measures analysis of variance (ANOVA) which is only one part of this study. It did not apply to the sample size needed for the other aspects of data analysis in this study.

RECRUITMENT

The principal investigator (PI) has a longstanding relationship with the study site and the nurses at the study site. The PI has previously worked at the study site as a registered nurse and clinical nurse specialist (CNS) and therefore she is familiar with the milieu of the site, the learning management system, and the electronic medical records systems used at this site. The sample for this study was recruited through the distribution of fliers and announcements at unit meetings (for all shifts) by the hospital educator or the PI at the hospital where the project was conducted. Fliers and announcements described the study, listed inclusion criteria, and contained the PI's email and phone contact information so that potential participants contacted the PI for more information. All interested participants completed a consent form explained by the PI. The PI was present to consent all potential participants. Participants completed the e-learning program, Preventing CAUTIs, in groups as participants were enrolled on an ongoing, weekly basis. Groups of participants ranged in size from approximately one to twelve. Participants accessed the e-learning program and study instruments with a computer and lab at the study site. Participants had access to a computer lab where they will be able to access and complete the CAUTI e-learning module at a time agreed upon by the PI and

participant. This was to ensure that the e-learning program was completed within the time frames established in the study. Completion time for the e-learning program, reaction survey, pre-test, and first post-test ranged from approximately 18-46 minutes. Rate of CAUTIs was collected for the start of 2015 and compared to rate of CAUTIs for one month after the e-learning program completion.

DATA COLLECTION

Data collected for this study was quantitative and qualitative. Data was collected using the following instruments. The timing of each data collection was noted for each instrument.

1. **Demographics**: An investigator developed tool was used to gather demographic information about the sample at the time of participant enrollment. The demographic information elicited by the instrument was: age, gender, ethnicity, education level, years in nursing practice, years employed at the institution, unit worked, and number of hours worked per week. See appendix C for a copy of the demographic tool.

2. **Reaction Tool**: The survey developed by Kirkpatrick (Kirkpatrick Partners, 2011) was utilized in the study immediately after completion of the e-learning program, preventing CAUTIs. The survey developed by Kirkpatrick (Kirkpatrick Partners, 2011) was utilized in the study immediately after completion of the e-learning program. The reaction survey was a tool that was not specific to e-learning programs. The survey consisted of 9 items scored on a Likert type scale where 1= strongly disagree, 2= disagree, 3= agree, and 4 = strongly agree. These items were scored individually or as a total. The items on the survey used a scale were interpreted using means and percentages. There are no psychometrics available for the instrument as it is used as a data collection tool with analyses conducted specific to the program and population (Linda Hawk with

Kirkpatrick Partners, email conversation, March 17, 2014). See appendix D for a copy of the reaction tool.

3. **Learning pre-test/post-test**: The hospital site developed test "Preventing CAUTIs" was administered as a pre-test and two post-tests. This knowledge test was developed by nurse educators and infection control nurses employed by the institution to evaluate knowledge acquisition with this e-learning program, Preventing CAUTIs. The test consisted of a 10 items (multiple choice, true/false, select all that apply) and was used to evaluate baseline knowledge level, knowledge acquisition, and knowledge retention. The test was scored by summing all of the items such that a higher score indicates more knowledge acquired/retained. The range of possible scores was 0-100. A pre-test was administered immediately prior to the start of the e-learning program, preventing CAUTIs (baseline knowledge). The first post-test (post-test one) was administered immediately after completion of the e-learning program, Preventing CAUTIs (knowledge acquisition). A second post-test (post-test two) was administered one month after completion of the e-learning program, Preventing CAUTIs (knowledge retention). The pre-test and two post-tests content and structure were identical. The tests were determined to have face validity by the team of nurse educators and infection control nurses at the facility. Additionally, the content was compared by the infection control nurses and nurse educators to the CDC CAUTI prevention guidelines. There was no reliability data available for this test. However, reliability was evaluated as part of the data analysis process once the pre and post-test data was collected. See appendix E for a copy of the Preventing CAUTIs test that was used.

The pre-test and post-tests were administered via paper-pencil, not utilizing the learning management system (LMS) for several reasons. Administering the tests via

60

paper-pencil allowed the PI to support follow through by the participants and thus possibly reduced attrition. Also, it was not reasonable to request the hospital to program additional pre and post-tests into their LMS for the purposes of this study. Paper copies of the tests were needed for comparisons and reliability determination during data analysis.

4. **Nurse self-reported behavior change tool:** A modified version of an existing Kirkpatrick survey (Kirkpatrick Partners, 2011) was used to measure nurses' self - reported behavior change. The survey consisted of thirteen items scored on a Likert type scale where 1= strongly disagree, 2= disagree, 3= agree, and 4 = strongly agree. These items may be scored individually or as a total. The items on the tool that used a scale were interpreted using means and percentages. There were four open ended questions on the tool that were interpreted. The open ended responses were not scored, but were summarized and reported. There was no psychometric data available for the instrument as it is used as a data collection tool with analyses conducted specific to the program and population (Linda Hawk with Kirkpatrick Partners, email conversation, March 17, 2014). This modified Kirkpatrick survey (Kirkpatrick Partners, 2011) was used to elicit nurses' self-reported behavior change as a result of completing the e-learning program. Some of the items on the tool addressed climate and rewards. The survey was given to participants at one month following the completion of the e-learning program so that participants had an opportunity to apply the knowledge acquired from the e-learning program to practice. See appendix F for a copy of the behavior change survey.

5. **Number of CAUTIs:** In order to assess the concept of results (step four), the number of CAUTIs that occur on the units where participating nurses work was recorded at baseline (prior to the e-learning program) for the time period starting January 1, 2015 until the start date of the e-learning program and for the duration of one month after

61

participants completed the preventing CAUTIs e-learning program. The e-learning program was designed to address the CAUTI rates for the 2015 so the time period starting January 1st was given to provide a clear rationale for the necessity of the e-learning program. The e-learning program was released to the medical surgical nurses on April 17, 2015 and it remained open through the study period (August 2015-February 2016). For the CAUTI rates for the one month time period after the study completion, it is possible that there were other factors that impacted this CAUTI rate in addition to the e-learning program, preventing CAUTIs. According to Kirkpatrick (1994), results (step four) can be hard to relate directly to an educational program beyond a reasonable doubt. It is important to evaluate the other concepts of the theory (reaction, learning, behavior) so that this data can be used to support results (step 4). Many factors may positively or negatively affect results (step four) and these factors must be disclosed by the researcher (Kirkpatrick, 1994). Additionally, the hospital used the e-learning program, preventing CAUTIs, to target the CAUTI rates.

INTERVENTION: CAUTI E-LEARNING PROGRAM

The role of the PI was to conduct the program evaluation, not to develop the e-learning program or the evaluation (knowledge test) tool. The e-learning program (preventing CAUTIs) was an existing program that was designed by the hospital, not the researcher. The e-learning program was developed by a team of nurse educators and infection control nurses working for the hospital. It was based on the most recent Centers for Disease Control (CDC) guidelines and evidence for prevention of CAUTIs. The CAUTI information from the CDC may have been new information for many of the nurses. This content contained new CDC guidelines and hospital policies based on these CDC guidelines. This study used the existing program that was delivered in the standard

method (e-learning) already in use by the study site hospital. A description of the e-learning module follows. The module consists of multiple static screens and 3 patient scenario examples. The following are the five e-learning program objectives based on current CDC guidelines:

At the completion of the program participants will be able to:

1. Discuss risks, benefits of urinary catheter use.

2. Describe signs and symptoms of urinary tract infection (UTI).

3. Describe interventions taken by the nurse to decrease the risk for UTIs.

4. Identify appropriate indications for indwelling urethral catheter use that are limited and include the following:

 - Perioperative use for selected surgical procedures, such as urologic surgery or surgery on contiguous structures of the genitourinary tract; prolonged surgery; large volume infusions or diuretics during surgery; intraoperative monitoring of urine output needed.

- Hourly assessment of urine output in patients in an intensive care unit (ICU).

- Management of acute urinary retention and urinary obstruction.

- Assistance in healing of open pressure ulcers or skin grafts for selected patients with urinary incontinence.

- As an exception, at patient request to improve comfort (eg, end-of-life care).

5. Perform comprehensive documentation of urinary catheter in Meditech.

DATA MANAGEMENT AND CLEANING

The IBM Statistical Package for Social Sciences (SPSS) version 23.0 (IBM, 2015) was used for data analysis. Data was entered into IBM SPSS 23.0 (SPSS, 2015) by the investigator and analyzed using descriptive, parametric and non-parametric tests. The one-tailed significance level was set at p=0.05. Univariate descriptive analysis was used

to check for accuracy and missing values. Missing data was managed by using pairwise deletion which is appropriate in this study so that all data that is collected is analyzed without any additional deletions of data (Nunnaly & Bernstein, 1994). The Cronbach's alpha reliability and internal consistency of the instruments and subscales was determined. Although a Cronbach alpha level for internal consistency of the instruments of 0.8 or higher is recommended for applied studies, it is acceptable to use a Cronbach alpha level of .70 for basic or general research (Nunnaly & Bernstein, 1994).

The analysis plans for each research question is given below.

RQ1: What are the reactions of nurses to the e-learning program, Preventing CAUTIs? Information collected using the reaction survey (Kirkpatrick Partners, 2011) was analyzed to obtain descriptive data to address this research question.

RQ2: What is the effect of the e-learning program, Preventing CAUTIs, on knowledge acquisition immediately after completion of the program and knowledge retention at 1 month after completion of the e-learning program? The pre-test and post-tests' data was collected from the Preventing CAUTI knowledge assessment via paper-pencil test. All data from these three tests was analyzed using repeated measures ANOVA to compare test scores across the three time points (pre-test, post-test 1, and post-test 2) and measure change from pre-test to post-test 1 to post-test 2. ANOVA was chosen for statistical analysis because it is a robust test that allows for the testing of means for more than 2 groups or factors (Borich, 2012). This study looked for differences between the means of 3 groups i.e. time points (pre-test, post-test one, post-test two). By using ANOVA instead of a t-test to analyze this interval level data, the power will increase and the type 1 error rate will decrease (Borich, 2012).

RQ3: In what ways did completion of the e-learning program, Preventing CAUTIs, impact the nurse's self-reported behavior change one month after e-learning program completion? Information will be collected using the modified behavior change self-report survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). The data was analyzed to obtain descriptive data to address this research question.

RQ4: What is the impact of climate on the application of e-learning program knowledge by nurses? Information was collected using the modified behavior change self-report survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). Some of the items on this survey addressed climate. These items were analyzed to obtain descriptive data to address this research question.

RQ5: What is the impact of the e-learning program, Preventing CAUTIs, on CAUTI rates? Number of CAUTIs within the units where nurses who participated in the program worked was recorded starting January 1, 2015 until the study start date and for one month after completion of the e-learning program.

RQ6: What are the relationships between nurses' reactions to, learning from, application of knowledge, and impact on results (CAUTI rate) after completion of the e-learning program, Preventing CAUTIs? Correlations between items on the reaction survey and post-test 1 were calculated to determine a relationship between nurse reaction and learning. Correlations between post-test 2 and items on the behavior self-report survey were calculated to determine a relationship between learning and behavior. This correlational data was also used to determine impacts of the concept of results.

Protection of Human Subjects

University of Texas at Austin and Healthcare Corporation of America (HCA) internal review board (IRB) approval was obtained by the PI. Participation was voluntary

and had no effect on employment status. All scores and participant responses were kept confidential and had no ramifications on employment status.

Potential risks to Participants

There were minimal to no risks to participants (nurses) in this study. Nurses in this study regularly participate in e-learning courses at the hospital. E-learning programs are a regular part of their job requirements for CE. The nurses are required to complete e-learning programs when initially hired and for CE (at least two times per year). Thus, the participants (nurses) were at no greater risk than they would be faced with in their normal day-to-day work.

There were no risks to patients in this study as patients were not included in this study. The only patient data included in the study was the rate of CAUTIs. This data was recorded and reported as an aggregate only without any individual patient data recorded. The data collected for each nurse will not be reported to the institution so there will be no impact on nurse employment related to this study.

PROTECTION AGAINST RISKS

All participant information was kept confidential and used only for the purposes of this study. Participants were assigned a personal code at the time that they signed the consent form. This personal code was recorded on/used for all tests, surveys, and tools to protect participant privacy and confidentiality. The personal code included: number of people living in household, street address number, and number of pets in the household. These numbers were combined to create the participant's personal code. Their names were recorded and matched to their personal code on one piece of paper only, the master code list, for tracking purposes. This paper and all data collected in the study was kept in

a locked cabinet in the PIs office or on a password protected computer used only by the PI. The PI protected confidentiality of all participants and all study data was reported in aggregate form.

Protection of Confidentiality

All surveys, tests, and demographic information was kept in a locked cabinet in the investigator's office or on a password protected computer that is only accessible by the PI.

Potential Benefits of this Project and Importance of the Knowledge to be Gained

This study may lead to improvements in e-learning design and evaluation that may improve nursing performance quality and that can lead to enhanced patient outcomes.

Summary

This dissertation study used a theoretically based evaluation process for the e-learning program, Preventing CAUTIs. This evaluation process may have the potential to be used in other e-learning programs. This may enhance the effectiveness of e-learning programs to support improvements in e-learning program design and implementation for the purpose of improving nursing practice and thus enhancing patient outcomes.

Chapter 4: Presentation of Findings

This chapter discusses the results of this dissertation study. The sample is described first, followed by a presentation of the descriptive statistics for all variables. Lastly, the results of analyses for each research question are presented.

The purpose of this study was to use the Kirkpatrick Theory (Kirkpatrick, 1994) to evaluate an existing e-learning program for hospital nurses, "Preventing Catheter Associated Urinary Tract Infections (CAUTIs)" (as an exemplar) to examine outcomes associated with e-learning programs for hospital nurses. This mixed methods study included the administration of a Kirkpatrick reaction tool (Kirkpatrick Partners, 2011), knowledge acquisition and retention tests, and a modified Kirkpatrick behavior change survey (Kirkpatrick Partners, 2011) to 48 medical surgical nurses at a large metropolitan hospital in a southern state. Rates of CAUTIs pre and post intervention were captured as outcome data.

Study procedures began with the participant signing consent for participation. Data collection immediately followed consent signing. Participants completed the demographics form and knowledge pre-test prior to starting the e-learning program. Participants were allowed to access the e-learning program at the study site's computer lab. Immediately upon completion of the e-learning program, all participants completed the first of two knowledge post-tests (acquisition). At this time, they also completed the reaction survey. The knowledge post-test was administered again at one-month post e-learning program completion (retention). The modified Kirkpatrick self-report behavior survey was administered at one month post e-learning program. CAUTI rates were collected quarterly starting in January 2015 before enrollment began until one month after the participants completed the e-learning program.

Data were collected by the principal investigator (PI) and the PI entered all data into the Statistical Package for the Social Sciences (SPSS) Version 23.0 (IBM, 2015). Data were cleaned and validated by the PI. All data points were analyzed for descriptive statistics and checked against acceptable (possible minimum and maximum) data responses for each variable.

The level of statistical significance set for this study was $p < .05$. Descriptive statistics including means, frequencies, and standard deviations were conducted to describe the study sample and study variables. Correlations and repeated measures analysis of variance (ANOVA) were performed to analyze the data. Statistical analyses were conducted to test for violations of assumptions. These analyses included tests for normally distributed errors and tests for homogeneity of variance (Mauchly's test of sphericity).

In order to compensate for expected attrition, the PI increased the required sample size by 18 participants (58%). Forty-six of the forty-eight participants enrolled, completed the study. Therefore, the observed attrition was 4.17%. One nurse went on maternity leave and did not complete the one-month follow up post-test or behavior self-report survey. Another nurse was lost to follow-up due to quitting her job at the study hospital and did not complete the one-month follow-up post-test or behavior self-report survey.

DEMOGRAPHICS

All 200 nurses at the study site were required to complete the e-learning program, Preventing CAUTIs, but not all of the nurses participated in this study. The convenience

sample of 48 hospital nurses who participated in this study was primarily female (81.25%), Caucasian (47.9%) and between the ages of 20-30 years (50%). Nurses reported their highest level of nursing education completed and these ranged from associate to master's degrees. See table 4.1 for a full description of the demographics of this sample.

Table 4.1 Sample Demographics

Item	Frequency	Percent
Gender		
Male	9	18.75
Female	39	81.25
Age		
20-30	24	50
31-41	16	33.3
42-52	4	8.3
53-63	4	8.3
Ethnicity		
African American	1	2.1
Asian	16	33.3
Caucasian	23	47.9
Hispanic	5	10.4
Native American	1	2.1
Pacific Islander	1	2.1
South Indian	1	2.1
Education level		
Associates	18	37.5
Bachelors	27	56.25
Masters	3	6.25
Note. *N*=48		

The nurses in this study reported practicing from 0-35 years. A majority was employed full-time at the study hospital; however, most had worked at the hospital for

less than one year. The study hospital has five medical surgical units (neurology, urology, renal, orthopedics, and telemetry). The telemetry unit includes an intermediate care unit (IMC). The nurses in the study were employed on one of these units. The unit with the highest number of participants was the telemetry/IMC with 22.9%. See table 4.2 for a full description of the participant education and employment demographics.

Table 4.2 Nursing Practice Demographics

Item	N	%
Years as a practicing nurse		
<1	18	37.5
1-3	12	25
4-6	7	14.58
7-9	2	4.17
≥10	9	18.75
Number of hours employed per week		
Fulltime	33	68.8
Part-time	3	6.3
PRN	12	25
Years employed at the hospital		
<1	41	84.5
1-3	1	2.1
4-6	3	6.3
7-9	1	2.1
≥10	2	4.2
Medical surgical unit worked		
Neurology	11	22.9
Orthopedics	7	14.6
Renal	3	6.3
Telemetry/IMC	16	33.4
Urology	11	22.9
Note. *N=48*		

See table 4.3 for a summary of the number of e-learning programs completed by the study participants prior to this study.

Table 4.3 Number # of E-learning Programs Completed

E-learning programs	N	%
0-20	10	20.8
21-40	15	31.1
41-60	6	13.3
61-80	2	4.4
81-100	4	8.8
>100	11	24.4
Note. *N=48*		

REACTION SURVEY RESULTS

Research Question 1: What are the reactions of nurses to the e-learning program, Preventing CAUTIs?

A reaction survey developed by Kirkpatrick (Kirkpatrick Partners, 2011) was used to measure participant satisfaction immediately after completion of the e-learning program and to answer research question 1. There are nine Likert type scaled items on the survey. The survey scores have a range of 1-4, with 1= strongly disagree and 4 = strongly agree. The item total correlations ranged from 0.46 - 0.92. Survey items 4 and 6 were duplicated; so removing one of these items (item 6) resulted in a Cronbach's Alpha of 0.91. There were no open-ended questions on this survey however, four participants wrote in narrative responses. Their responses are as follows:" terminology on the module is not the same as test"; "e-learning needs to be more specific and needs to be straight to the point"; no need for unnecessary information, needs improvement"; and "boring, hard

to determine what I need for my job". The results of the reaction survey are presented in table 4.4.

     The mean score range was 3.27-3.69 for the items. A ceiling effect was observed with the individual item scores. The item, "the program material will be helpful for my success in the future" scored the highest with a mean score of 3.69 on a scale of 1-4. The item, "there were no major distractions that interfered with my learning" scored the lowest with a mean score of 3.27 and had the largest standard deviation of 0.79.

Table 4.4 Participant's Reactions

Item	Mean	Standard Deviation	Range
1. I enjoyed this program	3.46	0.58	2-4
2. The program met my expectations	3.52	0.58	2-4
3. The program objectives were met	3.58	0.58	2-4
4. I was well engaged with what was going on during the program	3.48	0.55	2-4
5. I would recommend this program to my co-workers	3.56	0.54	2-4
7. There were no major distractions that interfered with my learning	3.27	0.79	1-4
8. I will be able to immediately use what I learned	3.65	0.48	3-4
9. The program material will be helpful for my success in the future	3.69	0.55	2-4
Note. $N=48$, item 6 deleted due to duplication			

LEARNING PRE-TEST/POST-TESTS

Research Question 2: What is the effect of the e-learning program, preventing CAUTIs, on knowledge acquisition immediately after completion of the program and knowledge retention at 1 month after completion of the e-learning program?

The knowledge tests administered at all three time points were identical. There were 10 forced answer questions (multiple choice, true/false, select all that apply). The pre-test was given immediately prior to starting the e-learning program to establish preexisting knowledge level (baseline). The first post-test (post-test one) was

administered immediately after the e-learning program completion and was used to examine knowledge acquisition. The post-test given at one month after the e-learning program completion (post-test two) examined knowledge retention.

The mean score for the pre-test was 35.9. The Kuder Richardson 20 (KR20) value for the pre-test was 0.59. The mean score for post-test one was 82.2 and the KR20 value was 0.53. The mean score for post-test two was 59.1 and the KR20 value was 0.50. Removing items from the test did not increase the KR20 values for the test at any of the three time points. The reliability of the knowledge tests was low and may have been impacted by the number of test questions, types of questions (multiple choice and select all that apply) and low correlation between the items. The range of scores for the knowledge tests was 0-100.

The knowledge test scores were compared across the three time points for statistical significance (see table 4.5), sphericity was assumed p = 0.199. Analysis of variance was used to determine statistical significance between changes in knowledge scores at the three testing time points (pre-test, post-test one, post-test two). When using a repeated measures analysis of variance (ANOVA), the mean test scores for knowledge were statistically significantly different df $(2, 90)$, F=83.58, $p < 0.001$. Post hoc tests using the Bonferroni correction found significant differences between pre-test and post-test one scores with p<0.001. In addition, there was a significant difference between post-test one and post-test two scores with p<0.001. There was a significant difference between pre-test and post-test two with p<0.001. There was a statistically significant increase in knowledge from pre-test to post-test one and from pre-test to post-test two. There was a statistically significant decrease in knowledge from post-test one to post-test two; however, post-test two scores remained significantly higher as compared to the pre-

test scores. The partial Eta squared for the relationship between knowledge scores and time was 0.65.

Table 4.5 Knowledge Change Over Time

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Time	49314.49	2	24657.25	83.58	.000*	0.65
Error	26552.17	90	295.02			
Note. (*n*=46). missing = 2 due to attrition; *significant at p<0.001						

NURSE SELF-REPORTED BEHAVIOR CHANGE:

Research Question 3: In what ways did completion of the e-learning program, preventing CAUTIs, impact the nurse's self-reported behavior change one month after e-learning program completion?

The modified Kirkpatrick behavior self-report survey (Kirkpatrick Partners, 2011) was used to measure a change in nurse practice behaviors and to answer research question 3. This survey has 13 items that use a Likert type scale with a score range of 1-4 (1=strongly disagree, 2=disagree, 3=agree, and 4=strongly agree). It also has five open-ended questions. The first 13 items are the scaled items and these items have a Cronbach's Alpha of 0.95 for this sample. This value was based on the 13 Likert type scaled items. The item total correlations ranged from 0.66 -0.85. There was no increase in the Cronbach's alpha score by deleting any items. The participant responses for the scaled items are shown in table 4.6.

Most of the items were rated on the higher end of the scale. The three highest scoring items (m=3.71 on a scale of 1-4) were: "My nurse manager supports my learning"; "my coworkers support my learning"; "I am motivated to change my nursing practice." The lowest scoring item (m=3.37) was: "I am rewarded or recognized for applying this knowledge to practice". This item also had the highest standard deviation value of 0.64. See table 4.6 for a full description of the behavior self-report survey (Kirkpatrick Partners, 2011).

Table 4.6 Modified Kirkpatrick Behavior Self-Report Survey Scaled Items

Item	Mean	Standard Deviation	Range
1. I am clear on how to apply what I learned on the job.	3.59	0.50	3-4
2. I am confident that I will be able to apply what I learned.	3.63	0.49	3-4
3. I am committed to applying what I learned to my work.	3.70	0.59	1-4
4. The hospital environment supports me in making changes to my practice.	3.67	0.47	3-4
5. My nurse manager supports my learning.	3.71	0.58	1-4
6. My coworkers support my learning.	3.71	0.50	2-4
7. Applying the knowledge from this program is a high priority.	3.67	0.60	1-4
8. I am motivated to change my nursing practice.	3.71	0.46	3-4
9. I have the time and supplies needed to incorporate changes in my practice.	3.54	0.55	2-4
10. I will help my coworkers incorporate this knowledge into their practice.	3.64	0.48	3-4
11. I am rewarded or recognized for applying this knowledge to practice.	3.37	0.64	2-4
12. My coworkers support me in making practice changes.	3.57	0.54	2-4
13. My nurse manager supports me in making practice changes.	3.63	0.49	3-4

Note. n=46, missing = 2 due to attrition

In addition to the 13 Likert type items; there were five open-ended questions on this modified Kirkpatrick self-report behavior survey (Kirkpatrick Partners, 2011). These questions and the nurses' responses are presented below.

Question: From what you learned, what will you be able to apply on your job?

Percent that responded to this question was 29/46, 63%. The responses were used to identify themes. The identified themes were:

1) Best practices of Foley catheter management including specimen collection, timely removal of Foley catheters, and the use of chlorhexidine wipes.

2) Proper indications for urinalysis/urine culture.

3) Use of knowledge to reduce Foley catheter complications such as falls and increased discomfort.

Participant quotes:

1) "I know how to take further steps to reduce CAUTIs."

2) "The majority of my patients have Foleys so I will be able to apply what I have learned about CAUTI prevention daily (Ex: chlorhexidine baths and scrubbing the of the tubing closest to the patient). I will also be able to apply what I now know about CAUTI rates to influence my urgency to reassess and remove Foleys as soon as possible."

3) "Be more aware of catheters and the risks when they are left in longer than needed."

4) "Make sure Foley is out in timely manner."

Question: What barriers do you anticipate that might prevent you from applying what you learned?

Percent that responded to this question was, 21/46, 45.7%. The responses were used to identify themes.

The identified themes were:

    1) Lack of time

    2) Lack of patient knowledge and cooperation

    3) Limited supplies

Participant quotes:

    1) "The busy unit and stress."

    2) "Patients who want the Foley out or in and there isn't an order or it is not needed for the patient."

    3) "Lack of time between patients with indwelling Foleys can lead to forgetting an item in the policy."

Question: Are there ethnic/culture barriers that may prevent application of the information from the program?

Percent that responded to this question was, 37/46, 80.4%. All of the participant responses were no, n/a, or none except for two participants. However, two participants responded:

"yes" and "Language barriers may prevent someone from understanding content."

Question: What might help to overcome those barriers?

The responses from the two participants that indicated the presence of barriers were:

"Patient education"

"Alternate translations"

Question: What outcomes are you hoping to achieve as a result of your efforts?

Percent that responded to this question was 34/46, 73.9%. The responses were used to identify themes.

The identified themes were:

      1) Decreased number of CAUTIs and length of hospital stay.

      2) Discontinue Foley catheter as soon as appropriate.

Participant quotes:

      1) "Prevent any Foley related infections."

      2) "Be able to share what I have learned and see the number of CAUTIs

         decrease."

      3) "To be the best nurse I can be."

Research Question 4 What is the impact of climate and rewards on the application of e-learning program knowledge by nurses?

Participant responses to seven items (4, 5, 6, 9, 11, 12 & 13) from the modified behavior change survey were used to answer research question 4. A summary of participant scores on these items are presented in table 4.7.

Table 4.7 Behavior Self-Report Survey Items that Addressed Climate or Rewards

Item	Mean	Standard Deviation	Range
4. The hospital environment supports me in making changes to my practice.	3.67	0.47	3-4
5. My nurse manager supports my learning.	3.71	0.58	1-4
6. My coworkers support my learning.	3.71	0.50	2-4
9. I have the time and supplies needed to incorporate changes in my practice.	3.54	0.55	2-4
11. I am rewarded or recognized for applying this knowledge to practice.	3.37	0.64	2-4
12. My coworkers support me in making practice changes.	3.57	0.54	2-4
13. My nurse manager supports me in making practice changes.	3.63	0.49	3-4
Note. *n*=46, missing = 2 due to attrition			

Open-ended item #15 addressed climate. The item was, "What barriers do you anticipate that might prevent you from applying what you learned?" Participant responses that related to climate include: time constraints, limited unit supplies, patient resistance to care, emergency situations, lack of time between patients, the busy unit, stress, and working night shift when patients and coworkers are reluctant to remove Foley catheters.

Research Question 5 What is the impact of the e-learning program, preventing CAUTIs, on CAUTI rate?

CAUTI RATES

The impact of the e-learning program exemplar, preventing CAUTIs, on CAUTI rates was examined in order to answer research question 5. Quarterly CAUTI rates were collected by unit and as an aggregate for the first quarter 2015 through the first quarter

2016. This time period encompasses the time prior to the e-learning program and the time that the e-learning program was made available to the nurses at the study hospital. The study site released the e-learning program to the medical surgical nurses on April 17, 2015 and it remained open through the study period. Participants (nurses) in this study represent a convenience sub-sample of the medical surgical nurses that completed this e-learning program. The CAUTI rates for 2015 (quarter 1, 2, 3, and 4) and 2016 (quarter 1) are presented by medical surgical unit and as an aggregate of all 5 medical surgical units in the tables 4.8 through 4.13.

Table 4.8 CAUTI Rates for Medical Surgical Renal Unit and Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	0
2015/Quarter 2	0
2015/Quarter 3	0
2015/Quarter 4	1
2016/Quarter 1	0

Table 4.9 CAUTI Rates for Medical Surgical Telemetry/IMC Unit and Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	1
2015/Quarter 2	1
2015/Quarter 3	0
2015/Quarter 4	0
2016/Quarter 1	1

Table 4.10 CAUTI Rates for Medical Surgical Neurology Unit and Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	2
2015/Quarter 2	0
2015/Quarter 3	0
2015/Quarter 4	1
2016/Quarter 1	0

Table 4.11 CAUTI Rates for Medical Surgical Orthopedics Unit and Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	3
2015/Quarter 2	2
2015/Quarter 3	1
2015/Quarter 4	1
2016/Quarter 1	1

Table 4.12 CAUTI Rates for Medical Surgical Urology Unit and Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	0
2015/Quarter 2	2
2015/Quarter 3	0
2015/Quarter 4	0
2016/Quarter 1	1

Table 4.13 CAUTI Rates for all Medical Surgical Units Summarized by Quarter

Summary year/Quarter	CAUTI count
2015/Quarter 1	6
2015/Quarter 2	5
2015/Quarter 3	1
2015/Quarter 4	3
2016/Quarter 1	3

Research Question 6 What are the relationships between nurses' reactions to, learning from, application of knowledge (behavior change), and impact on results (CAUTI rate) after completion of the e-learning program, preventing CAUTIs?

In order to answer research question 6, correlational analyses were performed. For the relationship between reaction and learning, correlational analyses were performed between participant mean scores for each item on the reaction tool and the post-test one score. These values are presented in table 4.14. The strongest correlation was observed between item seven "There were no major distractions that interfered with my learning" and the post-test one score. The relationship was not statistically significant.

Table 4.14 Item Correlations for Reaction Survey and Post-test 1

Item	1	2	3	4	5	7	8	9
Post-test 1 Pearson Correlation	-0.08	-0.17	0.02	0.08	-0.18	-0.24	-0.02	-0.15
Note. *N*=48, item 6 was omitted due replication								

For the relationship between learning and application of knowledge (behavior change) correlational analyses were performed between mean item scores for each of the behavior self-report survey items and the mean score for post-test two. The strongest observed correlation was between item six ("my coworkers support my learning") and post-test two mean score (r=0.30; p<0.05). These values are presented in table 4.15. The low number of CAUTIs made it difficult to conduct correlations between behavior (behavior self-report survey result scores) and results (CAUTI rates).

Table 4.15 Item Correlations for Self-Report Behavior Change Survey and Post-test 2

Item	1	2	3	4	5	6	7	8	9	10	11	12	13
Post-test 2 Pearson Correlation	-0.16	-0.01	0.04	-0.08	0.10	0.30*	0.17	-0.03	-0.02	-0.08	-0.26	-0.03	-0.06

Note. *N*=46, *=p<0.05

KIRKPATRICK THEORY

The Kirkpatrick theory (1994) was useful in providing a framework for the evaluation of this e-learning program's effectiveness. It provided a very practical and useable approach to the evaluation of this program. Each of the four steps (reaction, learning, behavior, and results) provided important data for the consideration of the overall program's effectiveness. The additional concepts of climate and rewards also provided important data to consider the program's effectiveness and gave additional factors that may have impacted the program's effectiveness. These two concepts may lead to important conclusions about factors other than knowledge that may impact behavior (application of education to practice) and results.

SUMMARY

This chapter discussed the findings from the statistical analysis of the data to a) evaluate the usefulness of the Kirkpatrick theory (1994) for evaluating e-learning effectiveness, b) describe nurse reactions to an e-learning program c) describe nurse knowledge acquisition and retention over time following completion of an e-learning

program, d) identify nurse behavior change after completing an e-learning program, e) to describe changes in rates of CAUTI over the study period, and finally f) explore the relationships between nurse reactions, behavior change, and knowledge retention. The study sample included 48 ethnically diverse bedside nurses who practiced in one of five medical surgical units at the study site, with the majority of nurses (33.3%) 20-30 years of age and 37.5% of the nurses had less than one year as a practicing nurse.

Nurses reported generally high positive reactions to the e-learning program; however, some chose to express 'write in' comments that revealed suggestions for improvement of the program. Nurse acquisition and retention of knowledge over time was significant as compared to baseline. Nurses identified ways in which their behavior changed because of the e-learning program. Most commonly, they said they were following best practices of Foley catheter management, using updated guidelines for collecting UA/UC, and using their knowledge to prevent Foley catheter complications. Outcomes measured (CAUTI rates) did not significantly change over the period of the study, however there was a downward trend (positive outcome) over time. Pearson correlations conducted to examine the relationships among variables showed generally low to moderate correlations. One of these items (there were no major distractions that interfered with my learning) showed a negative low to moderate relationship though not statistically significant relationship with post-test one scores, (r = -0.24). The strongest significant positive correlation, while still moderate, was between the item (My coworkers support my learning) and post-test two, (r =.30 p < .05).

The Kirkpatrick theory (1994) offered a structural approach (4-step) that was shown to be useful in evaluating the effectiveness of e-learning programs for nurses. The next chapter will be a summary of this dissertation and a discussion of the implications of

the findings. It will discuss the strengths, limitations, future nursing implications for practice, future policy implications, future research implications, future theory and education implications and conclusions.

Chapter 5: Discussion and Recommendations

This chapter includes a summary of this study and a discussion of the findings. It includes comparisons of these findings with other research, limitations of the study, and future implications for this research in regards to nursing practice, policy, education, research, and theory.

SUMMARY

The purpose of this study was to use the Kirkpatrick Theory (Kirkpatrick, 1994) to evaluate an existing e-learning program for hospital nurses, "Preventing Catheter Associated Urinary Tract Infections (CAUTIs)" (as an exemplar) to examine outcomes associated with e-learning programs for hospital nurses. Data was collected to examine each of the steps of this theory. The first step, reaction, was measured using a reaction survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). The second step of the theory, learning, was measured using a knowledge test developed by the study hospital and delivered pre and post e-learning program completion. The third step of the theory, behavior, was measured using a modified version of a behavior change survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). The fourth step of the theory, results, was measured using patient outcomes, rates of CAUTIs.

In order to examine these program outcomes, a convenience sample of 48 nurses employed by the study site hospital were included in the study. Of the total sample, 46 participants completed the study. The study sample was mostly female, aged 20-30 (50%), and ethnically diverse: Caucasian (47.9%), Asian (33.3%), Hispanic (10.4%), Pacific Islander (2.1%), Native American (2.1%), South Indian (2.1%), and African American (2.1%). The nurses were employed by the hospital on one of the five medical surgical units. To measure the effectiveness of the e-learning program and to achieve the

purpose of the study, several instruments were used for measurement of each of the steps of the Kirkpatrick theory (1994). The nurses in the study completed a reaction survey immediately after completing the e-learning program, Preventing CAUTIs. A knowledge test was completed by the nurses before, immediately after the e-learning program, and one month after the e-learning program was completed. The modified behavior change survey was administered at one month after e-learning program completion. CAUTI rates were measured by quarter capturing the time period starting before the study commenced and one month after the study ended. The findings were that nurses found the e-learning program useful. The knowledge increase from pre-test to post-test was statistically significant. The knowledge was retained from post-test one to post-test two, although there was a statistically significant decrease in knowledge from post-test one to post-test two, the knowledge increase from pre-test to post-test two remained statistically significant. The nurses in this study reported a positive change in behavior at one month after e-learning program completion. The CAUTI rates had a small decrease in the quarters following the launch of this e-learning program that was not statistically significant.

DISCUSSION

The instruments used in this study and the results of the study may contribute to knowledge about the effectiveness of e-learning programs for nurse continuing education (CE) by addressing gaps in the existing literature. The findings in the literature, the existing gaps, and the results of this study will be discussed as they relate to each of the steps of the Kirkpatrick theory (1994). One key factor in the development of this study was the increased use of e-learning programs reported in the literature (Philips, 2005). The sample represented in this study reported a higher than anticipated e-learning

program completion rate. Twenty four percent of the nurses in this study reported completing >100 e-learning programs. This suggests, as does the literature, that e-learning program usage is increasing and may be much wider than expected. 37.5% of the nurses that participated in this sample had one or fewer years of practice as a nurse. This gives the number of e-learning programs completed by these nurses a high practical significance. Nurses are exposed to and utilize e-learning programs at the beginning of their career and may continue to use a high volume of e-learning programs throughout their career.

Furthermore, some of the demographics of U.S. nurses reported in the literature are similar to the demographics of the nurses in this sample. The population of male RNs in the U.S. is approximately nine percent and approximately 82.8% of RNs in the U.S. are Caucasian (U.S. Department of Health and Human Services, Health Resources and Services Administration (HHS), 2010). Baccalaureate prepared nurses represent about 50% of the RN population and approximately 90% of RNs aged 25 or younger work in hospitals (HHS, 2010). According to research, the population of newer nurses working within hospitals is increasing steadily due to older nurses retiring or leaving the hospital setting due to workplace conditions or to pursue other employment (Orsolini-Hain & Malone, 2007). This phenomenon is described as the "expertise gap" (Orsolini-Hain & Malone, 2007). Another important concept explored in this study was the nurse's reaction to the experience of taking the e-learning program. This will be discussed next.

REACTION

The participants in this sample were administered a reaction survey designed by Kirkpatrick (Kirkpatrick Partners, 2011) immediately after completion of the e-learning program. This is the first use of the Kirkpatrick theory (1994) to examine e-learning

programs for hospital nurses. This was also the first use of the reaction survey developed by Kirkpatrick (Kirkpatrick Partners, 2011) in this setting and with this population. Information collected using the reaction tool showed that overall participants were satisfied with the e-learning program and found it useful. There was a ceiling effect observed, with the mean score for each of the items >3 (out of a possible max score of 4). These scores suggest that the nurses in this study reacted positively to the e-learning program, Preventing CAUTIs.

These findings are consistent with those reported in the literature which state that nurses and others involved in e-learning programs are satisfied with and enjoy the programs, appreciate their accessibility, and convenience (Atack et al, 2002; Atack, 2003; Billings et al, 2001; Gerkin et al., 2009; Lin, et al., 2006; McMullan et al., 2011; Patterson et al., 2012; Sears, et al., 2008; Seiler & Billings, 2004; Spiva et al., 2012). When e-learning programs are compared to traditional classroom programs, the literature reports that nurses find both of the program formats to be equally useful and satisfying (Spiva et al., 2012).

The results from the reaction survey were consistent with what has been reported in the literature. This survey may provide a consistent, theoretically based tool that can be used to measure learner reaction in future e-learning research studies for hospital nurses. According to Kirkpatrick (1994) a positive reaction should lead to learning. Nurse learning was evaluated next.

LEARNING

Learning is the second step of the Kirkpatrick (1994) theory. This was measured using a knowledge test, created by the e-learning program developers, that was administered three times over the study period. The reliability results for the knowledge

tests were low. The reliability results may have been due to the small number of items on the test or the low correlation between various items. There may be additional program development needed before the knowledge test is used in the future.

The pre-test measured baseline knowledge. Post-test one, measured knowledge acquisition immediately after the e-learning program was completed and post-test two measured knowledge retention at one month post e-learning program completion. There was a statistically significant increase in knowledge over time ($F_{(2, 90)} = 83.55$, $p<.001$). There was a statistically significant increase in knowledge from pre-test (M=35.87) to post-test one (M=82.17, $p<.001$). This finding is similar to those reported in the literature (Kontio et al., 2011; Mctigue et al., 2009; Schneidermann et al., 2009; Sears et al., 2008; Spiva et al., 2012). Additionally, there was a statistically significant increase in knowledge from pre-test (M= 35.87) to post-test two (M=59.13, $p <.001$). This suggests some of the acquired knowledge was retained at post-test two. There is no literature to compare these findings to, as evaluations beyond immediate post-test are not common in e-learning research studies and no literature was identified at the time of this study.

The mean post-test scores were highest at post-test one; however, both post-test mean scores were significantly higher than the mean pre-test scores. The decrease in score from post-test one to post-test two was 28.1%. Some of the knowledge decrease over time may be due to the new information in the e-learning program that contained CDC guidelines that represent a change in nursing practice related to CAUTI prevention. These findings are lower than the literature reports of a 2-3% retention rate for a one hour program at one month after completion (University of Waterloo, 2014). This may be due to factors mentioned in the literature that may impact retention. These factors are the type

93

of knowledge and frequency of knowledge application (Cohen et al., 1992; Custers, 2010).

This study was the first to examine knowledge retention of hospital nurses after e-learning program completion using a post-test at one month. It is important to examine knowledge retention, not just immediate acquisition, since many e-learning programs, including the one evaluated here, are used for annual continuing education (CE). According to Kirkpatrick (1994) as knowledge is retained, it will continue to positively impact behavior change and results over time. The findings obtained in this study contribute to the literature by providing data about hospital nurses' knowledge retention at one month after an e-learning program completion. This data can be used to substantiate the use of e-learning programs for hospital nurses and to contribute to future research in this area, including how frequently learning should be reinforced. Strategies to reinforce learning may be booster cues and application activities.

According to the Kirkpatrick theory (1994), an increase in knowledge acquisition may lead to behavior change. In this study, learning occurred at post-test one and was mostly retained at post-test two. According to the theory, learning must occur for behavior change to occur (Kirkpatrick, 1994).

BEHAVIOR

Behavior change was measured at one month after e-learning program completion using a modified self-report survey developed by Kirkpatrick (Kirkpatrick Partners, 2011). This survey has 13 Likert type scaled questions with a 1-4 scale and 5 open-ended items. Each of the items addressed application of knowledge to practice behaviors. The highest rated items were: My nurse manager supports my learning; I am motivated to change my nursing practice; my coworkers support my learning; and I am committed to

applying what I learned to my work. Therefore, the nurses in this study self-reported a positive change in behavior and the factors that support behavior change as a result of completing the e-learning program.

The five open ended items addressed behavior change at one month after e-learning program completion. The first item was, "From what you learned, what will you be able to apply on your job?" Responses included: when to request an order for a urinary culture (UC), how to obtain a sterile urine sample from a Foley, how to use chlorhexidine gluconate wipes to clean a Foley tubing, completion of catheter care at least every shift, indications for the use of a Foley catheter, documentation of Foleys, and assessing for increased risk of falls and discomfort that may result from a Foley. These responses indicate a commitment to applying this knowledge in practice to enhance patient outcomes.

To the second item "what outcomes are you hoping to achieve as a result of your efforts?" nurses stated that patient safety, best practice, low rate of CAUTIs were among their goals for practice after the e-learning program. The responses are supportive of utilizing the knowledge in practice to benefit patients and enhance outcomes. All of these open-ended responses suggest that nurses did apply their knowledge during the time period of one month after e-learning program completion and it can be hypothesized that they may continue to apply this knowledge to their practice to improve patient care.

The third open ended item had a very low response rate, with only 2 of the 46 participants responding. The open-ended item was, "Are there ethnic/culture barriers that may prevent application of the information from the program?" All but two nurses responded "no, n/a, or none." One of the nurses responded, "yes" and the other responded that these barriers may prevent an understanding of the content. Even though the sample

95

was only 47.9% Caucasian and there was a diversity of ethnicity/culture represented, a majority of the participants did not report any perceived ethnic/cultural barriers.

The fourth open ended item also related to culture/ethnicity. It asked, "What might help to overcome those barriers? Again the two participants that responded to the previous item also responded to this item. The responses were: "patient education" and "alternate translations". Culture/ethnic barriers were addressed in this study because some literature described this as a barrier to e-learning program use. However, the literature that described culture/ethnicity as a barrier was related to e-learning programs in general and not e-learning programs for nurses.

The fifth open ended item was, "What outcomes are you hoping to achieve as a result of your efforts? The response rate was 73.9% and the responses were very positive. Nurses wanted to decrease CAUTIs, improve patient outcomes, improve their practice, and share knowledge with their coworkers to further enhance patient outcomes.

None of the research studies reviewed at the time of this study, described behavior change (specifically as defined in this study) as a result of an e-learning program for hospital nurses. However, three studies were identified that reported an increase in self-efficacy (Smeekens et al., 2011), use of an electronic medication information resource (Straight, 2008), and a positive attitude change (Kontio et al., 2011) after e-learning program completion.

This study addressed a gap in the literature by providing data to describe the effectiveness of this e-learning program in changing the practice behavior of the nurses involved in this study. Additionally, the modified behavior change survey (Kirkpatrick Partners, 2011) used in this study was found to be efficacious in capturing self-reported behavior change in nurses following an e-learning program. These findings addressed a

gap in the literature by providing a potential tool to be used in future research and program evaluation of e-learning programs for hospital nurses. Self-reported behavior change is an important variable to measure to explore how knowledge gained from an e-learning program is utilized in practice. While self-report is not an objective measurement of behavior change, it is more than has been assessed in the existing literature, and therefore offers useful information that may assist with the examination of effectiveness of e-learning programs for hospital nurses. Future research may examine objective measures of behavior change such as review of nurse documentation.

REWARDS

"Rewards" is a concept discussed by Kirkpatrick (1994) that is rarely mentioned in the literature. Intrinsic and extrinsic rewards support behavior change. Rewards were measured using items from the modified behavior change self-report survey (Kirkpatrick Partners, 2011). The scaled item that addressed rewards was, "I am recognized or rewarded for applying this knowledge to practice." This item had the lowest mean (3.37) and the highest standard deviation (0.65) of all the items on this survey. This may indicate an issue within this organization with external rewards as perceived by the nurses in this study. Rewards, both intrinsic and extrinsic, support behavior change, the scores on this item may have negatively impacted behavior change (Kirkpatrick, 1994). While it was beyond the scope of this study to look at the longer term impact that external rewards may have on behavior change and maintaining a nursing practice change, it is important to note their potential impact on behavior.

Also, the open ended question, "What outcomes are you hoping to achieve as a result of your efforts" had comments that addressed intrinsic rewards. These were: better patient outcomes, increased patient satisfaction, and better nursing care. Rewards may

support or provide a barrier to behavior change. Based on the data from this study, extrinsic and intrinsic rewards were present to support a positive behavior change as evidenced by the overall nurse participants' responses to both the scaled and open-ended items.

Learning and behavior steps of the theory were correlated to determine any relationship between the variables. When post-test two items were correlated with the self- report behavior change survey, item 11 had a correlation value of -0.26. Item 11 addressed rewards, it was, "I am rewarded or recognized for applying this knowledge to practice." This suggests a potential inverse relationship with behavior. This may warrant further research as this does not support the theory and is not consistent with the data obtained from the open ended items. In addition to rewards, climate is a factor that may also impact behavior change (Kirkpatrick, 1994).

CLIMATE

According to Kirkpatrick (1994), a climate that is neutral, encouraging, and/or requiring will support behavior change. If a climate is preventing or discouraging, behavior change may not take place. Climate is a concept in Kirkpatrick's (1994) theory that is rarely addressed in the literature. Several of the scaled items on the behavior self-report survey addressed climate. The items, "My nurse manager supports my learning" and "my coworkers support my learning" each had mean scores of 3.71. These items had the highest mean scores of all of the scaled items on this survey. The item, "the hospital environment supports me in making changes to my practice" had a mean score of 3.68. This score is toward the high end of the 1-4 scale and supports the type of climate described by Kirkpatrick (1994) that facilitates behavior change. The items, "my coworkers support me in making practice changes" and "my nurse manager supports me

98

in making practice changes" had mean scores of (3.57 and 3.63). The responses to these items suggest that the nurses in this study perceived the climate to be encouraging or neutral. This is the type of climate that will enhance behavior change (Kirkpatrick, 1994). This program was required to be completed by all medical surgical nurses within the organization. This demonstrates a climate that is requiring and will support behavior change (Kirkpatrick, 1994).

Several of the open ended responses from the nurses on the behavior self-report survey addressed climate. One of the items was, "what barriers do you anticipate that might prevent you from applying what you learned?" The majority of the participant responses to this item addressed climate. Responses included: lack of time to review patient information related to Foley indications, limited unit supplies, emergency situations, time constraints, stress on the unit, lack of support from staff, need for reinforcement of the information, more guidance and support in use of the policy/protocols in practice. These responses represent numerous climate issues that may negatively impact behavior change. The most common issue in the responses related to time constraints. This is important information and will contribute to addressing a gap in the literature since none of the studies reviewed addressed climate.

The post-test two mean score was correlated with mean scores from each of the scaled items on the behavior change self-report survey; this was done to assess relationships between learning and behavior change. The strongest and the only statistically significant correlation was with item 6 (my coworkers support my learning) (r=0.30, p<0.05). This correlation supports Kirkpatrick's (1994) statement that a neutral, encouraging, or requiring climates foster behavior change. Learning, behavior, and climate all impact the results (outcomes) observed (Kirkpatrick, 1994).

RESULTS

Results (step four), was operationalized in this study as CAUTI rate. The observed CAUTI rate decreased throughout the time period after the initiation of the e-learning program. However, there was not an elimination of CAUTIs. The CAUTI rate at the study hospital was low to begin with; however each CAUTI occurrence has a major potential implication for the patient. Since the CAUTI rate was relatively low prior to the e-learning program launch, there may have been a floor effect, as there was not much room for the rates to go down.

There are many factors that may impact CAUTI rates in addition to this e-learning program. It is difficult to directly attribute the decrease in CAUTI rate to this e-learning program. However, since all of the nurses working on the medical surgical units of this hospital were required to complete this e-learning program, there is a potential for this e-leaning program to have impacted some of the CAUTI rate decrease. Each decrease in CAUTI rate has an impact on patient outcomes. This has practical significance since any decrease in CAUTIs has an impact on patient outcomes.

 Only one study identified in the literature used results (medication error rate) to evaluate the effectiveness of an e-learning program for hospital nurses (Straight, 2008). This study adds to the sparse literature on the evaluation of results following e-learning programs and provides data that this theoretically based approach to determining program effectiveness was useful.

STRENGTHS

The strengths of this study include: a) the successful use of the Kirkpatrick (1994) theory to evaluate an e-learning program for hospital nurses, b) the use of two instruments for an e-learning program evaluation for hospital nurses, c) the diversity of

the sample of hospital nurses who participated, and d) the first time that nurse knowledge retention, not only acquisition was tested following an e-learning program.

Kirkpatrick Theory

This was the first use of the Kirkpatrick theory (1994) to evaluate an e-learning program for hospital nurses and it was found to be useful because it provides an entirely theory driven, multi-step approach, to e-learning program evaluation. Examination of each of the steps contained in the theory (including climate and rewards) provides a comprehensive approach to e-learning program evaluation and determination of effectiveness. Data gathered at each level of the theory may be used to substantiate and/or improve e-learning programs for hospital nurses. This theory may continue to be used to measure e-learning program outcomes and make improvements to processes used to evaluate e-learning programs for hospital nurses.

Instrumentation

Two instruments were successfully used for the first time in this setting and population. The instruments were the reaction survey and the modified behavior change self-report survey (Kirkpatrick Partners, 2011). Both instruments had high reliability scores in this study.

Diverse Sample

The sample in this study was diverse in ethnicity, years of nursing practice, education level, and unit worked therefore adding to the generalizability of these findings to other settings.

Knowledge Retention

The results from this study provide support for knowledge retention from e-learning programs for hospital nurses at one month after program completion. The standard practice is to measure immediate knowledge acquisition, however, longer term measurements are needed to substantiate e-learning as an appropriate methodology for annual CE delivery for hospital nurses. However, knowledge scores did decrease at post –test two suggesting that knowledge boosters may be needed.

LIMITATIONS

While the contributions of this study were noted above, it is important to acknowledge that there were limitations. Namely they include: potential for bias and an inability to control for numerous confounding variables that may have contributed to CAUTI rates. The nature of the sample (convenience) has the potential to yield a biased sample as the nurses self-selected to participate. Therefore, these may be the individuals who are more likely to positively respond to the surveys. This may have influenced the overall assessment of the usefulness of this theory driven approach to e-learning program evaluation.

Additionally, the knowledge tests used in this study had low reliability. The validity measure was face validity and content was compared to current CDC guidelines. However, the test may not have been the best measure of knowledge acquisition and this may have impacted the study results. The correlations between the levels of the theory were mostly low and this may have also resulted from the quality of the knowledge test since the scores on this test were used in the correlations between levels of the theory.

It must also be noted that the major outcome variable (CAUTI rates) used in this evaluation process has a high potential for influence by a number of confounding

variables that were beyond the control of this study. For example, CAUTI rates may have been influenced by other healthcare team members involved in the care of patients with a Foley catheter. Also, climate and rewards may have impacted the CAUTI rates.

IMPLICATIONS FOR NURSING PRACTICE

The results of this study offer support for a theoretically based approach to evaluating nurses' knowledge acquisition and retention and application to practice following an e-learning program. With the increasing use of e-learning programs for nurses in hospitals, there is a need to evaluate their effectiveness. This study provides support for a theoretical and practical approach that can be used in nursing practice to evaluate future e-learning programs for hospital nurses. Since medical errors rank as the 3rd leading cause of death in the United States (U.S.), the importance of CE for hospital nurses is very high (Makary & Daniel, 2016). CE is often used in the hospital setting to address patient outcomes including medical errors. These programs need to be evaluated in a theoretical framework to determine the effectiveness of the programs. The Kirkpatrick theory (1994) provided a successful, multi-step approach to evaluating these e-learning programs that includes an examination of concepts of climate and rewards that may impact e-learning program effectiveness. Consideration of climate and rewards is important to include in e-learning program evaluation because there are other factors within hospital systems that may impact the effectiveness of e-learning programs.

In addition, two surveys (reaction & behavior change), were validated for use in the hospital nurses in this study with Cronbach's alpha scores of 0.91 and 0.95 respectively. These existing surveys may be used in practice to evaluate reaction to and behavior change as a result of e-learning programs for hospital nurses. In addition, the

103

validation of two surveys for reaction and behavior change may encourage the measurement these concepts.

IMPLICATIONS FOR POLICY

The findings of this study may contribute to the knowledge of e-learning program evaluation and the use of the Kirkpatrick theory (1994) for evaluation. Hospitals may develop policies that incorporate the use of this theory when evaluating e-learning programs for hospital nurses. Often, hospitals include e-learning programs in initiatives to enhance patient outcomes and decrease complications. E-learning may be used alone or partnered with other activities within the hospital system to achieve improvements in patient outcomes. Hospitals may incorporate e-learning programs into graduate nurse orientation programs. The positive reaction of nurses to this e-learning program and their high scores of self-reported behavior change may further influence hospital administrators and nurse educators to utilize e-learning programs for nurses. However, there needs to be an evaluation process in place to determine the effectiveness of the programs in the short-term and long-term. The Kirkpatrick theory (1994) could be used to design policy around the evaluation of the e-learning program effectiveness. Future e-learning programs may be used as was this exemplar to target specific issues within a hospital that may be resolved partially or fully through the creation of policy and procedures that incorporate the use of the Kirkpatrick theory (1994) to evaluate e-learning programs for hospital nurses. In order for this future research to be conducted, hospitals must adopt policies that facilitate researcher access to the facilities, nurses, and data, especially objective data, to continue to conduct research.

IMPLICATIONS FOR EDUCATION

Beyond the hospital, these findings offer implications for undergraduate nursing education programs. Many undergraduate nursing programs utilize e-learning programs as an educational methodology. Additionally, many nursing students must complete required nursing e-learning programs in order to gain access to clinical sites. This research may be used to evaluate the effectiveness of those e-learning programs by using the Kirkpatrick theory (Kirkpatrick, 1994). In addition, some undergraduate nursing programs may choose to incorporate e-learning programs into their curriculum in order to prepare their students for the e-learning that they may encounter in nursing practice. The Kirkpatrick theory (Kirkpatrick, 1994) may be used to evaluate the short-term and long-term impacts of these e-learning programs.

At the graduate nursing education level, the results of this study may be used to incorporate e-learning program development, implementation, and evaluation into programs that are preparing future nursing faculty or nurse educators. With continued e-learning expansion, the use of e-learning, creation of e-learning programs, as well as implementation, and evaluation of these programs are becoming essential skills of nurse education in the hospital setting. The Kirkpatrick theory (1994) may be taught as an evaluation method for e-learning programs for hospital nurses.

IMPLICATIONS FOR FUTURE RESEARCH

This mixed methods study sought to use an e-learning exemplar to examine the use of the Kirkpatrick theory (1994) to evaluate e-learning programs for hospital nurses. The results were supportive of the use of this theory for the evaluation of this e-learning program for the hospital nurses in this study. With the increasing use of e-learning for education for hospital nurses, it is important to study this methodology using a

theoretically based approach. Much of the increased use of e-learning for hospital nurses may be related to its benefits which include: mass availability, convenience, accessibility, standardized approach, cost reduction, versatility, and efficiency (Ally, 2004; Johnson, Robertson, Barrett, Jarrell, Hunter, & Mendoza, 2012; Phillips, 2005; Seiler & Billings, 2004; Spiva, et al., 2012). Though even with these benefits, there needs to be a theoretical approach to evaluating e-learning programs to ensure their effectiveness. This theory may be useful to determine the effectiveness of future e-learning programs for nurses in the hospital setting. It provides a comprehensive examination of e-learning programs using a multi-step approach. The data gathered at the different steps of the theory provide a depth of understanding of the program effectiveness that is valuable for use in future research. In addition, two measurement tools (reaction & behavior change), used in this study had high internal consistency reliability. These tools may be used in future research for e-learning program evaluation using the Kirkpatrick theory (1994). It may helpful to have an item or items on the behavior change self-report survey that directly ask the learner if they have used the knowledge in practice and to describe how.

Also, future research should continue to examine e-learning effectiveness in different populations of nurses and utilizing different topics. Research studies that use this theory in specialty areas other than medical surgical and in different hospitals throughout the U.S. will continue to build the knowledgebase. In addition, future research may correlate individual demographic information with reaction, learning, and behavior to look for factors that may impact the effectiveness of e-learning at the different steps of the theory.

Comparisons of hospital based e-learning programs for nurses to traditional classroom based programs found that the programs are equally effective for knowledge

106

acquisition (Kontio, Lahti, Pitkanen, Joffe, Putkonen, Hatonen, & Valimaki, 2011; Moule, Albarran, Bessant, Brownfield, & Pollock, 2008; Spiva, Johnson, Robertson, Barrett, Jarrell, Hunter, & Mendoza, 2012). This study did not use a control group in its design (traditional classroom). However, it may be useful to use this theoretical approach to compare multiple groups (e-learning vs. classroom) in future e-learning research.

Some of the barriers discussed in the literature were not found in this research study. These were: computer literacy, learning style, learning disabilities, and ethnicity/culture (Gerkin et al., 2009, Howatson-Jones, 2004; Muilberg & Berge, 2005; Patel, 2007; Ubon, 2002). There was no mention of computer literacy, learning disability, or learning style difficulties in any of the open ended items to assess barriers. Ethnicity/culture was addressed by two open ended items on the behavior change self-report survey. One open-ended item was, "Are there ethnic/culture barriers that may prevent application of the information from the program?" 76% (35/46) of the nurses responded no or n/a to this item, 2 of the 46 respondents responded differently. One of the nurses responded, "yes" and the other responded that these barriers may prevent an understanding of the content. The other open ended item that addressed ethnicity/culture was "What might help to overcome those barriers?" The two participants that responded to the previous item also responded to this item. The responses were: "patient education" and "alternate translations". The majority of the participants did not describe any ethnic/culture barriers that may have prevented the application of knowledge from this program. Even though the sample was 47.9% Caucasian, there was a diversity of ethnicity/culture represented and a majority of the participants did not report any perceived ethnic/cultural barriers.

Another important issue related to e-learning is knowledge retention. The Kirkpatrick theory (1994) supports the evaluation of knowledge using repeated measurements at appropriate time intervals, but no specific time intervals are delineated in the theory. This study looked at knowledge retention and self-reported behavior change at one month after e-learning program completion. This was the first study of knowledge retention in this population. Traditionally, studies only evaluated knowledge acquisition immediately after program completion. It is important to continue to build knowledge about longer term knowledge retention and possible strategies and supplementation that might increase knowledge retention. Future research should also explore long-term nurse behavior change, and patient outcomes. Longer term (greater than one month) measurements are needed to substantiate e-learning for annual CE of hospital nurses. Future research may seek ways to extend knowledge retention by combining e-learning with knowledge reinforcement or other education methodologies such as role play or simulation.

To obtain objective measures of behavior change, future research may review nursing documentation. This may allow researchers to see if certain education objectives contained in the e-learning programs utilized are instituted in nursing practice. Review of nursing documentation may provide a valuable look at the actual actions of nurses in regards to their patients.

The concepts of climate and rewards highlighted potential areas for future e-learning research in this population. More in depth research with the use of open ended questions, interviews, or focus groups may gather important aspects of nurses' perceptions of the role these concepts may play in their organization. The long-term impact of climate and rewards on behavior change is another important area for future

research. If there are not adequate external rewards and/or the climate is not conducive to behavior change, the long-term impact on nurse behavior change is unknown.

Additionally, the relationships between the concepts in the theory warrant further research. The mean scores for each of the items on the reaction survey were correlated with the mean score for the post-test one to determine a relationship between the variables of reaction and learning. The highest correlation was item seven with a (r= -0.24) though the relationship was not statistically significant. This item was, "There were no major distractions that interfered with my learning." This may suggest an inverse relationship such that the participant's perception of environmental distraction may have negatively impacted their post-test one score and interfered with their learning. This may suggest other factors impacted learning. Future research should look at the relationships between reaction and learning. Also, a more in-depth examination of the correlation between the other levels of the theory is needed.

The relationship between learning and behavior were determined by correlating the mean scores on each of the scaled items from the behavior change self-report survey and the mean post-test two scores. Both of these scores were obtained at one month after e-learning program completion. There was only one correlation between item six on the behavior change self-report tool and the post-test two scores that was statistically significant (r=0.30, p<.05). All of the other correlation values ranged from -0.26-0.17. This demonstrates a weak correlation between the items on the behavior change self-report survey and post-test two. Although this relationship is not strong, there may be a correlation between these two levels of this theory. This may not have been the best measure of the correlation of these two levels of the theory. Reviewing the open-ended questions from the behavior self-report survey suggest that the participants did use the

knowledge they obtained from the e-learning program to apply to their practice. Therefore, measuring the behavior change survey and post-test two correlations may not have clearly shown the relationship between knowledge at one month and participant application of this knowledge and future research in this area is warranted.

IMPLICATIONS FOR THEORY

This research study used the Kirkpatrick (1994) theory for the first time to examine an e-learning program for hospital nurses. This study provided evidence that this theory is a useful theory for use in examination of e-learning programs for nurses. The theory is unique in that it measures multiple aspects of a program to determine program its effectiveness. This was the first study with an e-learning program for hospital nurses to employ an entirely theory driven design that examined all aspects of the theory utilized. Most prior research in e-learning programs for hospital nurses did not mention any use of theory (Alemagno, et al., 2010; McTigue, et al., 2009; Moule et al., 2008; Straight, 2008). A few studies mentioned theory, but a thorough description of the theoretical framework and its role in the study design was not included (Hart, et al., 2008; Schneidermann, et al., 2009).

This was the first use of the Kirkpatrick Theory (1994) for the evaluation of an e-learning program for nurses. This was also the first use of this theory in its entirety for the evaluation of an e-learning program. The findings in this study support the use of the theory in its totality. That is, all of the concepts must be addressed in order to have an effective program evaluation. Two of the concepts that had particular importance in this study and are rarely discussed in the literature are climate and rewards. The items that addressed these concepts in this study brought out important issues that may impact behavior (application of knowledge to practice) and results (patient outcomes). The issues

110

may suggest that learning (knowledge acquisition) may not be the only concept that contributes to behavior change and then to results. The results of this study suggest that rewards and climate may play a much larger role in behavior change and results in this population. Future use of this theory should incorporate measures of all of the four steps (reaction, learning, behavior, and results) and this study suggests the concepts of climate and rewards should be measured and included as major concepts in the theory. The results of this study suggest that the theory may be more than the traditional "4 steps" as climate and rewards in this study show a high potential impact on other concepts within the theory specifically for the e-learning programs for hospital nurses. In addition, the results of this study suggest that these concepts may impact behavior and results over time. Some longitudinal measure of the concepts contained within this theory is essential. Many hospital nurses are expected to utilize the education from e-learning programs for annual education. As such, long-term measurements of the concepts must be included in program evaluation. The concepts of climate and rewards may contribute to the effectiveness of e-learning programs in the long-term. Such that learning may occur but may not directly lead to behavior change if there are issues with rewards and/or climate.

CONCLUSION

This chapter discussed the findings of this dissertation study and the implications of the findings for nursing practice, policy, education, research, and theory. The findings of this study provide a foundational knowledgebase for utilizing the Kirkpatrick theory (1994) in future e-learning program evaluations for hospital nurses. This study provided a theoretically driven evaluation of an e-learning program that may be duplicated in future e-learning research for nurses in other hospitals and across specialties. This provides a theory driven evaluation process where there was no current evaluation process. Further,

the measurement tools used in this research study had high reliability and may be used as part of theory driven evaluations of future e-learning programs for nurses. This study also obtained knowledge measurements at multiple time points. The majority of the existing research only obtained data immediately after e-learning program completion. The data obtained related to the knowledge, behavior, and results (outcomes) concepts of the Kirkpatrick theory support future research aimed at longer term measurements of these concepts. Additionally, the concepts of climate and rewards have little mention in the literature. The data obtained related to these concepts creates a starting point for future research. The findings of this study may suggest that these concepts have impacts on behavior and results. This is an important component to be considered in the future evaluation of e-learning programs for hospital nurses.

Appendices

Appendix A- Institutional Review Board Approval Letter

OFFICE OF RESEARCH SUPPORT

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 · Mail Code A3200
(512) 471-8871 · FAX (512) 471-8873

FWA # 00002030

Date: 08/18/15
PI: Amber L Shammas
Dept: Nursing
Title: E-Learning Programs for Hospital-Based Nurses

Re: IRB Amendment Approval for Protocol Number 2015-04-0095

Dear Amber L Shammas:

In accordance with the Federal Regulations for review of research studies, the Institutional Review Board (IRB) reviewed your requested amendment to the above referenced protocol and found that it met the requirements for approval.

Approval for your study expires on 06/11/2016. *Expires 12 a.m. [midnight] of this date.*

The following requested changes were approved:

Revised the protocol and informed consent document to remove nursing documentation in Meditech review.

☐ Continue to use the original approved consent form(s).
☒ Use the attached approved informed consent document(s).
☐ You have been granted a Waiver of Documentation of Consent according to 45 CFR 46.117 and/or 21 CFR 56.109(c)(1).
☐ You have been granted a Waiver of Informed Consent according to 45 CFR 46.116(d).

Responsibilities of the Principal Investigator:

1. Report immediately to the IRB any unanticipated problems.

2. Submit for review and approval by the IRB all modifications to the protocol or consent form(s). Ensure the proposed changes in the approved research are not applied without prior IRB review and approval, except when necessary to eliminate apparent immediate hazards to the subject. Changes in approved research implemented without IRB review and approval initiated to eliminate apparent immediate hazards to the subject must be promptly reported to the IRB, and will be reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the subjects continued welfare.
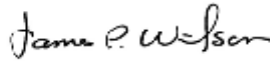
3. Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to participate.

4. Ensure that only persons formally approved by the IRB enroll subjects.

5. Use only a currently approved consent form, if applicable.
    Note: Approval periods are for 12 months or less.

6. Protect the confidentiality of all persons and personally identifiable data, and train your staff and collaborators on policies and procedures for ensuring the privacy and confidentiality of subjects and their information.

7. Submit a Continuing Review Application for continuing review by the IRB. Federal regulations require IRB review of on-going projects no less than once a year a reminder letter will be sent to you two months before your expiration date. If a reminder is not received from Office of Research Support (ORS) about your upcoming continuing review, it is still the primary responsibility of the Principal Investigator not to conduct research activities on or after the expiration date. The Continuing Review Application must be submitted, reviewed and approved, before the expiration date.

8. Upon completion of the research study, a Closure Report must be submitted to the ORS.

9. Include the IRB study number on all future correspondence relating to this protocol.

If you have any questions contact the ORS by phone at (512) 471-8871 or via email at orsc@uts.cc.utexas.edu.

Sincerely,

James P. Wilson

James Wilson, Ph.D.
Institutional Review Board Chair

Appendix B Consent For Participation

Consent for Participation in Research

Title: E-learning Programs for Hospital-Based Nurses

Introduction

    The purpose of this form is to provide you information that may affect your decision as to whether or not to participate in this research study. The person performing the research will answer any of your questions. Read the information below and ask any questions you might have before deciding whether or not to take part. If you decide to be involved in this study, this form will be used to record your consent.

Purpose of the Study

    You have been asked to participate in a research study about effectiveness of e-learning programs for hospital –based nurses. The purpose of this study is evaluate the effects of an e-learning program, preventing catheter associated urinary tract infections (CAUTIs), on nurse reaction, nurse knowledge acquisition and retention, nurse documentation, and CAUTI rates using a systematic, theoretically based approach.

What will you be asked to do?

    If you agree to participate in this study, you will be asked to
- Complete tests and surveys at designated time points

This study will take place over a period of approximately two months duration. During this period of time you will be asked to complete one pre-test and two post-tests and two surveys at designated time points. The time required of you to complete the entire study is approximately 60-120 minutes.

What are the risks involved in this study?

    There are no foreseeable risks to participating in this study.

What are the possible benefits of this study?

    You will receive no direct benefit from participating in this study. The purpose of this study is to gain new knowledge about e-learning programs for hospital nurses. This knowledge may lead to changes and/or improvements in the overall design, implementation, and evaluation of future e-learning programs.

Do you have to participate?
    No, your participation is voluntary. You may decide not to participate at all or, if you start the study, you may withdraw at any time. Withdrawal or refusing to participate will not affect your relationship with The University of Texas at Austin (University) in anyway.

    If you would like to participate please sign the bottom of this form and return to Amber Shammas who may be contacted by phone at 512-576-7168 or via email at ambershammas@utexas.edu .You will receive a copy of this form.

Will there be any compensation?
    You will not receive any type of payment for participating in this study.

How will your privacy and confidentiality be protected if you participate in this research study?
    Your privacy and the confidentiality will be protected by creating a personal code that will be used in place of your name on all study documentation. All information will be kept in a locked drawer in the researcher's office and / or on a password protected computer accessible only to the researcher. Your identifiable information will not be shared without your consent or disclosed to your employer. Future publications and reports will not identify you as a participant and the information reported will be generalized. Your identifiable information will be destroyed three years after the study enrollment and procedures have been completed.

    If it becomes necessary for the Institutional Review Board to review the study records, information that can be linked to you will be protected to the extent permitted by law. Your research records will not be released without your consent unless required by law or a court order. The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate it with you, or with your participation in any study.

Whom to contact with questions about the study?
    Prior, during or after your participation you can contact the researcher **Amber Shammas** at **512-576-7168** or send an email to ambershammas@utexas.edu for any questions or if you feel that you have been harmed.
    This study has been reviewed and approved by The University Institutional Review Board and the study number is **2015-04-0095.**

Whom to contact with questions concerning your rights as a research participant?
    For questions about your rights or any dissatisfaction with any part of this study, you can contact, anonymously if you wish, the Institutional Review Board by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu.

Participation
    If you agree to participate please return this signed form to Amber Shammas.

Signature

    You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. You voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights.

_____

Printed Name

_____   _____

Signature   Date

As a representative of this study, I have explained the purpose, procedures, benefits, and the risks involved in this research study.

_____

Print Name of Person obtaining consent

_____   _____

Signature of Person obtaining consent   Date

Appendix C Demographics Sheet

Demographics Sheet
Participant code:

1. Are you male ☐ female ☐

2. What is your age?_____

3. What is your ethnicity/culture?

Asian ☐ Hispanic ☐ African American ☐

Caucasian ☐ Other ☐ please specify_____

4. What is the **highest** level of nursing education that you have completed?

Diploma ☐ Associate's Degree ☐ Bachelor's Degree ☐

Master's Degree ☐ Doctorate ☐

5. How many years have you been a practicing as a licensed RN? _____

6. How many years have you been employed at St. David's North Austin Medical Center?

Less than 1 year ☐ 1-3 years ☐ 4-6 years ☐ 7-9 years ☐

10 years or more ☐

7. On what unit do you work?

8. What is your position on the unit?

9. How many hours per week do you work at St. David's North Austin Medical Center?

Full-time ☐ part-time ☐ prn ☐

10. Approximately how many e-learning programs have you already completed?

Appendix D-Reaction Tool

Participant code:

Participant Survey

Instructions: Thinking about the course you just completed, please indicate to what degree you agree with each statement using this rating scale:

1 = Strongly Disagree	2 = Disagree	3 = Agree	4 = Strongly Agree

I enjoyed this program.	1	2	3	4
The program met my expectations.	1	2	3	4
The program objectives were met.	1	2	3	4
I was well engaged with what was going on during the program.	1	2	3	4
I would recommend this program to my co-workers.	1	2	3	4
I was well engaged with what was going on during the program.	1	2	3	4
There were no major distractions that interfered with my learning.	1	2	3	4
I will be able to immediately use what I learned.	1	2	3	4
The program material will be helpful for my success in the future.	1	2	3	4

Appendix -E Preventing CAUTIs Pre-test/Post-test

Preventing CAUTIs Test

Participant code:

1. All of the following are ways to prevent urine flow from backing up into the bladder and maintain an unobstructed urine flow EXCEPT:

Use the green sheet clip to prevent a dependent loop in the catheter tubing.

Let the collection bag lie on the floor so it is as far below the bladder as possible.

Completely empty the collection bag prior to transport from unit to unit or from unit to a procedural area.

Drain urine from the catether tubing before turning the patient.

2. Each day that a Foley is in place, the risk of a patient developing a UTI increases by:

10%

5%

30%

25%

3. After placing a new Foley catheter, the specimen should be collected from the first 15-30cc of urine to get the most accurate sample.

True

False

4. When performing a CHG bath on a patient with a Foley catheter, the nurse will:

Wipe the perineal area and the entire length of the Foley catheter tubing from the meatus outward.

Wipe the perineal area then vigorously wipe the Foley catheter tubing for at least 15 seconds from the meatus

Do not use the CHG wipes on the perineal area

Wipe the perineal area and 6 inches of the Foley catheter tubing from the meatus outward.

5. Nurses need to review the necessity of every Foley at least every _____?

8 hours

12 hours

Day

This is not a nursing responsibility; the necessity must be reviewed by the physician.

6. Foley catheters cause increased: (select all that apply)

Patient discomfort

Antibiotic resistance

Risk for falls

Length of stay

7. A urine sample must be sent to the lab within _____ to prevent overgrowth of contamining organisms.

30 minutes

1 hour

2 hours

4 hours

8. If a Foley catheter has been in place longer than _____ days and a urine culture is ordered, the Foley must be replaced prior to obtaining the specimen.

3

5

7

9

9. If a patient arrives to the hospital with a Foley catheter, the catheter must be replaced and a urine culture drawn upon admission to monitor for any UTIs that were present prior to arrival.

True

False

10. Which of the following are appropriate indications for Foley use: (select all that apply)

Acute urinary retention

Hematuria requiring bladder irrigation

Urine measurement for patients requiring use of diuretics

Aid in pressure ulcer healing of Stage III or Stage IV pressure ulcers

Increased comfort for patients on hospice and requiring palliative care

Prolonged immobility due to a condition resulting in the inability to use a bedpan (hip or pelvic fracture, etc)

Patient request to assist with the patient's ability to sleep through the night

Appendix F- Behavior Change Self Report Survey

Participant code:

Kp

Participant Survey

Instructions: Thinking about the course you just completed, please indicate to what degree you agree with each statement using this rating scale:

| 1 = Strongly Disagree | 2 = Disagree | 3 = Agree | 4 = Strongly Agree |

I am clear on how to apply what I learned on the job.	1	2	3	4
I am confident that I will be able to apply what I learned.	1	2	3	4
I am committed to applying what I learned to my work.	1	2	3	4
The hospital environment supports me in making changes to my practice.	1	2	3	4
My nurse manager supports my learning.	1	2	3	4
My coworkers support my learning.	1	2	3	4
Applying the knowledge from this program is a high priority.	1	2	3	4
I am motivated to change my nursing practice.	1	2	3	4
I have the time and supplies needed to incorporate changes in my practice.	1	2	3	4
I will help my coworkers incorporate this knowledge into their practice.	1	2	3	4
I am rewarded or recognized for applying this knowledge to practice.	1	2	3	4
My coworkers support me in making practice changes.	1	2	3	4
My nurse manager supports me in making practice changes.	1	2	3	4

From what you learned, what will you be able to apply on your job?

What barriers do you anticipate that might prevent you from applying what you learned?

Are there ethnic/culture barriers that may prevent application of the information from the program?

What might help to overcome those barriers?

What outcomes are you hoping to achieve as a result of your efforts?

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