2013

Examining Nursing Students' Retention of Taught Content by Repeat Study and Repeat Testing: A Replicated Study

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by

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A capstone project submitted to the faculty of
Gardner-Webb University School of Nursing
in partial fulfillment of the requirements for the degree of
Doctorate of Nursing Practice

Boiling Springs

2013

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Approval Page

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Abstract

This project was a replication of a previous study conducted with medical residents to determine if repeat testing produced higher scores as compared to repeat study. Current literature reports that repeated testing produces higher scores than repeated studying. This project was conducted with first semester nursing students who were provided a learning session on two topics, followed by a multiple-choice test and review sheet for each topic. Two groups were randomly assigned. Each group tested on either Topic A or Topic B (Asepsis and Oxygenation) and studied the other topic. Testing sessions were held on the teaching day, at two weeks and at three months following the initial teaching session. Final tests compared using *t*-tests show the mean scores are 21% higher (p = 0.00) for the students who tested as compared to the students who studied the topics.

Keywords: self-testing, testing effect, spacing effect, retrieval, long-term retention, and test-enhanced learning

Acknowledgments

I would like to express my sincere appreciation to Dr. Janie Best and Dr. Annette Hines for their mentoring, support, and continued motivation throughout this project. The guidance they have provided has been invaluable in helping me with time management, data analysis, and a consistent presence. Both are valued mentors and true friends.

My grateful appreciation is also acknowledged to the Gardner-Webb faculty and Capstone Committee. Their enthusiasm and support throughout the program and project has been an encouraging delight.

A note of thanks is extended to Dr. Susan Harvey and Lori Krause for direction from the beginning of the project, and from my colleagues who provided support and valuable feedback on the project. Other friends who have always offered encouraging words include Kathy Willis, Carrie Rowell, and the Dilworth family.

Finally, I must express my appreciation to my family, who has provided continual support during my educational pursuits. My husband, Mike, has continually been a rock of support through four different nursing degrees.

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CHAPTER I

Introduction

A dedicated endeavor of nurse educators is for students to learn instruction and become safe and knowledgeable clinicians, and successfully pass the National Certification Licensure Examination (NCLEX), either for Registered or Practical Nurses. The journey through nursing school is filled with a myriad of tests, developed to elicit assessment and evaluation for successful outcomes. Nurse educators are acutely aware that nursing schools must maintain adequate pass rates on the NCLEX examinations and that an acceptable pass rate is a requirement of the accrediting bodies (CCNE, 2009; NLNAC, 2012; NLN, 2012). Therefore, it is imperative that nursing educators are aware of the most effective methods of instructing a diverse student population in order to improve learning and long-term retention of the essential information.

Many authors have documented the effectiveness of repeated testing on learning and it has "led many researchers to advocate for the use of testing as a learning tool" (Butler, 2010, p.1131). Because the evidence of *repeated retrieval practice* versus the *repeat study method* has been deemed as successful and well documented in cognitive psychology, it would be advantageous for nursing faculty to use this approach in all areas of teaching, including nursing (Karpicke & Roediger, 2008).

Problem Statement

Nursing educators desire for content to be learned and retained for a successful NCLEX pass and for use within clinical practice. How can the enormous amount of content that must be learned and applied for licensure and clinical practice be obtained? Understanding what practices have been successful in testing and studying allows

researchers to explore the best practices of how to guide students to retain learned content.

Justification of Project

The most current form of teaching in nursing curriculum is a lecture followed by a test (McDaniel, Roediger, & McDermott, 2007). Evidence states an increase in testing scores are obtained when testing is combined with learning activities (Banning, 2005; Kaddoura, 2011; Kohtz, 2006). August-Brady (2005) states there is limited research on learning in nursing education; therefore it was this project administrator's intent to broaden that body of knowledge to include nursing students. Each nursing student must learn a large amount of content and also apply the concepts to actual clinical practice. Effective engagement in the learning process, such as "deep learning", is crucial to achieving positive results for successful nursing students (Cohen, Manion & Morrison, 2004; Popkess & McDaniel, 2011). Deep learning, versus surface or superficial learning, occurs when students display a self-regulatory method of learning instead of a memorization of the taught content (August-Brady, 2005). For example, superficial learning occurs with memorization and a lack of contemplating topics in depth, whereas deep learning occurs when knowledge is applied and new discoveries are made in an independent study environment. Instead of the traditional lecture on content, the student is stimulated to search and ask questions to explore the topic in depth (Cohen et al., 2004). The project has provided an examination of data specific to nursing students' retention of content and a foundation to further explore the topic of retaining content in nursing curricula.

Purpose

The primary purpose of this project, *Examining Nursing Students' Retention of Taught Content by Repeat Study and Repeat Testing,* was to replicate a study performed with medical residents utilizing a repetition of testing and studying. In the original study, the authors reported a higher percentage of retention when testing was coupled with study versus only a repeat study without testing (Larsen, Butler & Roediger, 2009). Findings of the replicated study will contribute to nursing education by enlightening nursing educators and promoting nursing students' retention and application of learned content for a longer period of time.

Project Hypothesis and Questions

The project administrator's hypothesis was that nursing students would have higher scores from a method of study-test-test instead of a method of study-study-test. The following questions were answered:

1. After initial learning, did the repeat study of content improve scores after three months?
2. After initial learning, did the repeat testing method improve scores after three months?

Definition of Terms

It is important to note that most of the research about student testing lies within the cognitive psychology domain. Therefore, the key concepts discussed within cognitive psychology research are defined:

- Deep learning – a deliberate, effective and intrinsic learning (Cohen et al., 2004; Floyd, Harrington, & Santiago, 2009)

- Superficial learning – learning to meet minimal requirements (Cohen et al., 2004)
- Massed study – performing study in a single session (Elvers, Polzella, & Graetz, 2003)
- Testing effect – student learning is increased when tested on content instead of studying without testing (Karpicke, Butler, & Roediger, 2009)
- Spacing effect – spreading out learning content produces more learning than if studying is condensed (Dempster, 1989)
- Test-Spacing effect – "testing that is spaced over time" promotes learning (Dempster, 1989; Larsen, Butler, & Roediger, 2008, p. 961)
- Repeated retrieval method – repeated attempts to recall learned information (Karpicke et al., 2009; Karpicke & Roediger, 2008; Pyc & Rawson, 2007)
- Test-enhanced learning – learning that is achieved by testing over a spaced time (Boulet, 2008; Larsen et al., 2008).

Summary

This project was a replication of a study performed with medical residents to determine if a repeat in testing produced higher scores than a repeat in study. Much literature reports that repeat testing produces higher scores than repeat studying. Questions were asked if scores were improved after testing or after studying. The primary purpose of this project was to explore if testing would produce higher scores for nursing students than studying alone.

CHAPTER II

Research Based Evidence

The purpose of this project, *Examining Nursing Students' Retention of Taught Content by Repeat Study and Repeat Testing,* was a replication of a study conducted with medical residents, in which scores of repeat testing and repeat study were evaluated. In the original study, the authors reported a higher percentage of retention when testing was coupled with study versus only a repeat study without testing (Larsen et al., 2009). A review of the literature has established that assessment in the form of testing is an ongoing process conducted by nursing educators and may be used for grading purposes, assessing students' abilities, or evaluating what learning has occurred. The literature review highlights some of the many articles available on testing and testing effects.

Review of Literature

There is sufficient literature related to learning in the cognitive psychology discipline and medical disciplines, but the literature is limited in the nursing discipline. Various researchers have performed studies on testing and the retention of learned knowledge. Search engines for the literature review included Cumulative Index for Nursing and Allied Health Literature (CINAHL), Applied Cognitive Psychology, and Academic Search Complete. Key words explored in the literature include self-testing, testing effect, spacing effect, retrieval, long-term retention, and test-enhanced learning. Studies and discussions on testing and retention are presented within this paper, categorized under the headings of Students' Learning Methods, Testing, and Testing Effect and Retrieval.

Students' Learning Methods

In first investigating the literature on methods used by students, there are many references in which authors' report students reread or restudy information for learning or testing purposes because it provides a confidence of knowing the information (Butler, 2010; Dempster, 1989; Larsen et al., 2009; McDaniel, Howard, & Einstein, 2009; McDaniel et al., 2007; Pyc & Rawson, 2010; Roediger, Putnam & Smith, 2011). One such study reported by Karpicke et al., (2009) explored the characteristics and behaviors specific to student learning and an examination of strategies students used for personal study. Of the 177 students surveyed, the strategy that ranked highest was "rereading notes or textbook" (p. 475). The following two strategies that students used were "do practice problems" and "rewrite notes" (p. 475). The authors reported that very few students engaged in any self-testing or retrieval practice as a strategy. The hypothesis was supported when most students re-read or re-wrote notes instead of self-testing. The term *labour-in-vain* was discussed that described the vast amount of time spent in the activity that does not produce positive testing results. Eighty-four percent of undergraduate students (n = 177) reported that reading was the most used strategy, whereas using a recall method was reported by two students (1%). The importance of the study revealed that students do not realize the valuable impact that self-testing has on retaining information. An earlier study that discussed the illusions of competence aspect contained three experiments, which reported results of students' erroneously over-estimating success on future tests when the answers were in front of them (Koriat & Bjork, 2005). Additionally, other issues reported in the literature that prevented students from adequate learning are a lack of study time, inability in knowing what to study or

how to space out their study process, and ceasing study time before mastery of the learned information was achieved (Nelson & Leonesio, 1988; Roediger et al., 2011).

Massed study, a concentrated study during one study session, is one of the preparations that students use before an examination (Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Dempster, 1989; Dempster, 1991; Donovan & Radosevich, 1999; Kornell, Castal, Eich, & Bjork, 2010; Melton, 1970; Pyc & Rawson, 2007). Reasons for this method included procrastination or studying harder versus easy items (Pyc & Dunlosky, 2010). The latter study reported students' confidence was higher after massed study; however a study by Zimmer (1994) reported less anxiety occurred during testing if space testing in spaced intervals was performed. Karpicke et al. (2009) suggested that students perform the re-reading of content to develop *illusions of competence*. The illusion of confidence promoted an elevated overconfidence of the content due to the familiarity of the previously read material and students did not feel a need for practice by self-testing methods. Pyc and Dunlosky (2010) performed three experiments looking at the hypotheses of massed, spaced, and metacognitive study. The study reported some students think massed was the best learning method, others think that once the item has been studied, it should not be studied again immediately; and lastly, others made a decision after an initial study session whether the item had been learned well enough to re-study then or later.

In two experiments conducted by Butler, Karpicke and Roediger (2007), participants read passages, followed by questions. Three different methods of feedback were provided: no feedback, immediate feedback, or delayed feedback after a distracter. The authors reported the delayed feedback method had the highest score, thereby

proposing that students will process feedback more thoroughly if required to answer each question until correct instead of allowing students to review by their own methods.

In summary, in the many testing studies that have been performed, the consensus was that testing is a more productive means of learning and should not be used exclusively for grading purposes. As previously noted, the direct effects of testing allow students to recall the information better at a later date, and the indirect effects, such as frequent testing, cause students to study more. In order to promote optimal learning in nursing students, using testing more in the classroom is reported as an effective method to increase test scores and long-term retention.

Testing

This literature review highlights some of the many articles available on testing. The interest in testing and how to increase retention is evident from the distant past. One example in the late 1800s, a work by William James entitled The *Principles of Psychology,* (Green, n.d.). James commented on why cramming for a test, versus interacting with the content on different occasions in different contexts, is not the best method for a student who desires to remember the material. Larson et al. (2009) reported their findings in which a group of medical residents tested had a 13% higher score six months later, as compared to the group who only studied. The authors' conclusion was that testing is a valuable tool for learning and not just for assessment. The project reported in this paper is a replication of the Larsen et al. (2009) study with medical residents. Boulet (2008) also stated that evidence is plentiful that shows testing students was beneficial to learning, and an instructor should consider what is tested and

how often testing is performed. The article stated well-constructed tests are essential to successful learning.

Kornell, Hayes and Bjork (2009) report many other sources about testing and learning from the early 1900s to the present, thereby showing a continued interest and intensive study on the topic of testing and learning. They examined if incorrect answers inhibited learning, and an experiment that showed that challenging students with questions on unlearned material is beneficial to learning when paired with feedback. In a study by McDaniel et al. (2007), the authors commented that testing was studied early in the 20th century, became more prominent during current times and has expanded to explore the various learning benefits. They conducted three experiments which expanded previously reported research to include more extensive learning material, and found that a short-answer test given initially boosted a higher score on a final test.

In a study by Karpicke and Roediger (2008), students who repeated testing on pairs of words recalled 80%, whereas students who did not repeat testing of the words recalled 36% or less. The authors concluded that "taking a test leads to better retention than re-studying the material for an equivalent amount of time" (p. 961). Others noted particulars from this study are the importance of delaying feedback after testing, testing more often, and providing short-answer tests.

Authors Roediger et al. (2011) listed 10 benefits of testing, which included increased retention, improved organization and metacognition, and study enhancement. A term noted in the chapter is *test-potentiated learning*, defined as taking a test before a future topic is studied, and the data showed the students learned more by taking the test than just studying the topic. Another study cited within the chapter reported higher

scores after subjects alternated study periods with testing. Besides increasing the retention of facts, students who used testing were better able to attain new knowledge. The authors also cited that the act of testing will provide a student with a more precise assessment of the content versus confidence by rereading. The premise of the chapter addresses the fact that students do not realize the positive impact testing provides in self learning. In addition to tests helping students improve learning, authors Roediger et al. (2011) and McDaniel et al. (2007), addressed that faculty should be attentive to the incorrect answers, provide feedback, and administer more testing sessions to drive study motivation.

Kromann, Bohnstedt, Jensen, and Ringsted (2010) noted the testing they performed on a skill, cardio-pulmonary resuscitation, did not produce a high effect size, but reported several limitations due to a small sample and a large dropout rate. They conclude that even though the effect size was small, the testing done along with the practice may cause a longer retention span and recommend more research on the retentions of skills combined with testing.

The consensus of the literature on testing states that it is a valuable tool when coupled with researched strategies, such as the testing effect (Spurlock, 2011). Roediger and Karpicke (2006) reported that even though research states testing improves learning, educators abstain from testing in the classroom, possibly due to the time framing that requires the test creation and/or if grading is required (McDaniel et al., 2007). The frequency of testing or quizzing is one method the authors stated will push students to study on an ongoing basis, versus a massed period before a large test. Two terms discussed were t*he direct effect of testing,* described as the remembrance of material

when tested versus not being tested, and *the indirect effects of testing*, described as an increase of study based on frequent testing or a change in study strategies that may include a focus on weak areas (Larsen et al., 2008, p. 959, 960; Roediger & Karpicke, 2006).

Testing Effect and Retrieval

Pyc and Rawson (2010) described that memory is improved by testing, which involves retrieval and decoding processes in the brain. Memory development is further enhanced when retrieval is used during an initial testing session and then by additional testing (Larsen et al., 2008). The results of the latter report are shown to be even higher when spaced out over time and when feedback is provided, even if it is delayed feedback. These concepts are found in the literature as the testing effect and test-spaced testing, respectively.

The concept of the testing effect has been shown in experiments to enhance learning and long-term retention. Karpicke and Roediger (2007) reported that students' study methods may not produce the optimal results for retention. In a later article by the same authors, they reported that students should test themselves often; however, most students are not aware how valuable testing can help them initiate retrieval processes in the brain (Karpicke et al., 2009).

In a similar report by Toppino and Cohen (2009), the authors emphasized how the testing effect is advantageous to retention. The research question presented in the article was if retention was due to a study process or retrieval. After an experiment using word pairs, they reported that memory was strengthened by study, but retrieval was

strengthened by testing, and retrieval strengthens the content storage versus the act of restudying the content.

There was sufficient literature to support that spacing time between testing sessions increases retention, but the question about the specific intervals between the testing was unknown. Karpicke and Bauernschmidt (2011) confirmed with their study that longer intervals between testing produced much greater gain of retention. The authors' research consisted of an experiment with 12 various spacing intervals, using pairs of words, and a varied spacing interval between the subjects recalling the correct words to match. The study reported that the overall spacing of testing does increase score improvement, but the specified spacing may not be as important. In a similar study by Pyc and Rawson (2011), the authors discuss an experiment with undergraduate students who studied word pairs on flashcards, comparing those who studied all pairs each time and those who dropped a pair after correct recall. The findings reported students who dropped a pair of words after correct recall performed lower on the final test performance, than students who continued to study the pairs at a second learning session.

In an article by Rawson and Dunlosky (2011), experiments were conducted that explored the retrieval of learning. The article opened with a quote from Bahrick that stated: "Much of the information acquired in classrooms is lost soon after final examinations are taken" (p. 283). The research question was to determine "how much retrieval practice is enough to achieve … efficient learning" (p. 300). Two limitations from the copious studies cited were: (1) very few studies include a criterion level of learning (minimum score required); and (2) usually only one initial learning session was conducted. The authors stressed a vital important point that learning occurs

cumulatively; therefore, a relearning event enhances retention. Undergraduates were involved in experiments that were carried out during one to four month intervals similar to the time frames students experience between semesters. As in many colleges, there is an initial learning and relearning that is inevitable, when course material is introduced on an advanced level in a later semester. The study reported the most positive results of retention was from an initial learning session that contained "three correct recalls", followed by three relearning sessions, which the authors referred to as the "3 + 3 schedule" (Rawson & Dunlocksy, 2011, p. 300).

More recently, additional experiments reported students predicted that learning would occur more with massed study than with a spaced effect (Logan, Castel, Haber, & Viehman, 2012). Four experiments were conducted using words in which students predicted how well the words were to be remembered, identified as "judgment of learning" (p. 178). Massed and spaced learning methods (words repeated or words spread throughout the experiment) were conducted and students underestimated the final higher performance result on spaced words versus the massed words.

Gaps in Literature

The literature clearly provides positive reports of recall, but more studies on application of the knowledge is needed (Larsen et al., 2008). When searches were instigated with the key words regarding testing with nursing, no studies were found. The studies that populated were focused on retention in nursing school, testing for diagnostic tests or how learning experiences are blended in particular courses. A gap clearly exists in the literature specific as to how nursing students can learn for retention of the information in order to produce successful outcomes. Several of the articles already cited

in this paper have noted that there is a gap in the applicability between the learned knowledge of this actual practice and its use in the classroom setting (McDaniel et al., 2007). The authors reported that many of the studies included learning words instead of passages of content and concluded that "testing is a powerful tool to promote learning in educational situations" (p. 205).

Strengths and Limitations of Literature

Many of the articles already cited report the data obtained from experiments that provide increases in learning after using the testing effect or testing more often (Butler, 2010; Chan, 2010; Fitch, Drucker, & Norton, 1951; Leeming, 2002; McDaniel et al., 2009; McDaniel et al., 2007; Pyc & Rawson, 2011). The literature provides much information on testing of students, however not specific to nursing students. Of the studies noted in the paper, cognitive psychology dominated the studies, with many of them performed with psychology students. Nursing education is a high-stakes environment, culminating with the NCLEX exam and then working with life-death situations; therefore, retention of nursing content is crucial (Spurlock, 2011). Findings from the psychology studies are a beginning place to incorporate the same type testing to nursing students, thereby increasing the potential for faculty and students to strengthen learning processes.

Theoretical/Conceptual Framework

Pender's Health Promotion Model (HPM) provided the theoretical framework for this project. The project was based on the concept of self-reflection and a modification of behavior which involves a change in health promotion due to a cognitive-perceptual factor. The Social Cognitive Theory is a learning theory which is attributed to Bandura,

and on which Pender's HPM is based. Bandura's Theory parallels Pender's Theory in that a person can self-regulate their actions for desired achievements. Self-efficacy is one of Bandura's constructs and explains that a person with self-efficacy views tasks as a challenge rather than a threat (Saylor, 2011). The forces that enhance one's self-efficacy are described by Bandura as having a successful experience, seeing others succeed, receiving encouragement from others and experiencing an emotional response during a performance. The three major concepts identified in Pender's model mirror the project's hypothesis:

1. Individual characteristics – a student developed a method of study that has resulted from prior behaviors and actions

2. Behavior-specific cognitions/affect – a student has perceived thoughts of study methods based on the benefits or barriers of prior study and personal self-efficacy

3. Behavioral outcome – a student commits to a plan of study that produces a desired outcome (Current Nursing, 2012; Young, Taylor, Renpenning, 2001; Tomey & Alligood, 1998).

Pender's model, revised in 1996, was applicable to this project in which the prior behavior of traditional study only was compared to systematic testing in order to learn nursing content. The HPM has a classification system that expresses beliefs that are essential for nursing assessment and implementation. Some of the propositions within the HPM are affect, attitudes, activity, aspirations, and accomplishments (Young et al., 2001). As a nursing student is learning a topic, a needed affect is alertness, and a needed attitude and activity is self-motivation and assuming responsibility. Self-actualization is an expression of aspiration and a sense of achievement correlates with a feeling of

accomplishment. Pender stated cognitive-perceptual factors influence behaviors (Young et al., 2001). As students discover higher scores are obtained due to a longer retention of content, the study strategy of massed studying will be modified to a strategy of testing and retrieval methods. See Figure 1 for the Conceptual-Theoretical-Empirical (CTE) structure for the project.

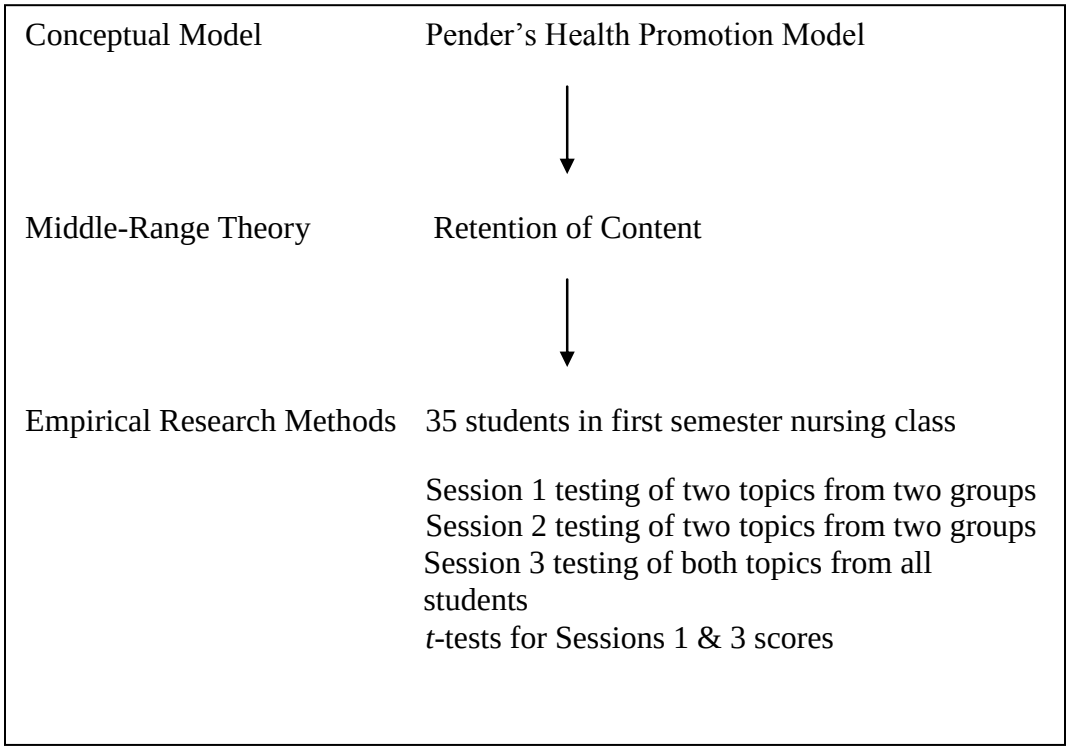

Figure 1. Flow chart of the CTE model. (Fawcett, & Garity, 2009)

Summary

The current literature on retention of learned content was plentiful within the psychology discipline, however was lacking in nursing research. The numerous studies explained the various testing methods of retaining learned content that are statistically proven to enhance retention; therefore, it is imperative this information is communicated with nursing faculty and students, so to achieve the best outcomes of using testing to improve retention.

CHAPTER III

Project Description

This project, named *Examining Nursing Students' Retention of Taught Content by Repeat Study and Repeat Testing*, was a replicated study in which the scores of nursing students were examined after three sessions that consisted of testing and study opportunities. The original study was performed with medical residents for examination of final scores after testing and study sessions. This project was implemented to contribute additional learned information to the body of nursing knowledge.

Project Implementation

The nonexperimental design used in this quantitative project consisted of evaluating and comparing scores of nursing students from two randomly assigned groups: each group studied a topic and took a test. The final test contained questions on both topics. The two topics, asepsis and oxygenation, were chosen by the Chair of the Baccalaureate Science of Nursing (BSN) program of the visiting institution. The Chair of the project and Preceptor for the class were in agreement for the specified topics.

Setting

The setting of the project was a baccalaureate nursing program in a small, liberal arts university in the southern region of the United States. The room was large and adequately spacious to accommodate the students and desks.

Sample

The convenience sample consisted of enrolled nursing students (n=36) in a first semester Fundamentals nursing course. The demographics consisted of females and males of various ages and ethnic backgrounds. The demographic sample was not typical

for all first semester nursing classes across the United States, as other institutions may have more gender or ethnic background variations.

Project Design

The content that was taught and tested on was selected by the Chair of the BSN program, based on the individuality of the topics, the combination of cognitive and psychomotor domains, and both appropriate to be taught at the beginning of the semester. The two teaching topics of asepsis and oxygenation were within the required textbook, each in a separate chapter, and listed on the course syllabus. An agenda for the initial teaching session and testing was constructed and approved by the chair and preceptor. The agenda used is found in Appendix A. Detailed instructions are listed that were performed and the time limits for each activity.

The groups were randomly assigned upon entering the room, and placed in Group A or Group B. A student placed in Group A was given a yellow index card and a student placed in Group B was given a blue index card. The student was instructed to write their name on the card.

Each participating student was given a written consent statement that was read aloud to them by the project administrator. Students were allowed the opportunity to ask questions. A copy of the consent is found in Appendix B. Informed consent was obtained from all the students. Students were informed that they may opt out of the project at any time, and their names or scores would be kept confidential until the study was completed, and then destroyed. The consent explained participants would be learning two topics that were listed on the course syllabus. Students would not receive any extra credit for their participation within the course or penalty for not participating.

After the objectives and tests had been created, the first meeting consisted of two 50-minute teaching sessions that were administered per the agenda with an Asepsis and Oxygenation Case Study handout, with a 10 minute break between the sessions. The sessions contained the same information as the tests. Each Case Study was an interactive activity in which students had to work in groups and then answer the questions on the handout as the project administrator specified.

Students were in a large room, in which individual students' desks were easily moved into separate, small groups of 5-6 facing each other. The project administrator was able to move about the classroom with ease when addressing the groups. After the Case Study participation sessions were completed, the students turned their desks to face the front of the class and were given a test, dependent upon what color of index card they had. Students with yellow cards received an asepsis test and students with blue cards received an oxygenation test. The preceptor and project administrator proctored the test until time was called and all tests were brought to the front of the class. The three days of testing are described in three sessions.

Session 1: At the end of the teaching session, the students turned their individual desks to face the front of the class. Each student was given a test that corresponded with their index card: students with yellow cards received the asepsis test and students with blue cards received the oxygenation test. After finishing the test, which took approximately 20 minutes to complete, the students were given the answers to compare with their selections and a review sheet on the other topic: Group A (asepsis) were given a review sheet on oxygenation and Group B (oxygenation) were given a review sheet on

asepsis. Students were not allowed to keep the review sheets, the test or answer sheets (Appendices C and D).

Session 2: Two weeks following the initial teaching session and the first study/test session, Group A took the same test on asepsis and Group B took the same test on oxygenation. After completion and collection of the tests, students were given an answer sheet to compare their answer choices and a review sheet on the opposite topic. The same tests, answer sheets, and review sheets were identical as in Session 1.

Session 3: Nine weeks after the initial teaching session, a Debriefing Statement was read to the students, which consisted of appreciation for their participation and how to contact the project administrator for further information on the project. A copy of the Debriefing Statement is in Appendix E. Both groups were given a final test on both topics, which contained 40 questions, all questions identical to the previous tests. After completion and collection of the tests, an answer sheet for the test was provided and returned to the project administrator.

Protection of Human Subjects

The demographics of the subjects were non-identifying and reported in the aggregate. IRB approval was obtained from the visiting and the project administrator's institutions. Data collection is protected in a password protected database.

Instruments

Test questions were created by the project administrator in a multiple choice format, similar to class exams. Each question had four answer choices. Each test consisted of 20 items. Review sheets on each topic were created from the textbook content. Question-answer sheets were created that provided the questions, the correct

answers, and the rationales. The review and question-answer documents were given to students to review after each testing session. The tests, review sheets, and question-answer sheets were approved by the Chair and Preceptor from the visiting university.

Data Collection

The data collected were the scores from the three tests, which were created by the project administrator. The first and last tests scores were the primary focus for the data collection and analysis. The tests were graded by marking a strike through incorrect answers and calculating the score based on the number correct divided by the total number of questions. After each testing session, the tests were scored and entered into a password protected computer. The results were provided to the project chairperson and preceptor.

Data Analysis

The final test scores for each session were compared using dependent and independent paired *t*-tests on the asepsis and oxygenation tests. Group A (Asepsis) was calculated by an independent *t*-tests, due to mortality (attrition) of the original testing group, and to protect confidentiality as no student identifiers were linked to the tests. Four students from Group A were not in attendance on the last testing session. In Group B (oxygenation) all students were present at the first and last sessions; therefore a dependent *t*-test was calculated. Any p-values < 0.05 were considered significant. Tables 1 and 2 show the descriptors for each group. In Table 1, the columns of Week 1, Week 2, and Week 3 represent individual testing sessions. The last column (Oxygenation) represents the data from the Asepsis Group on the final test, specific to the oxygenation questions. In Table 2, the columns of Week 1, Week 2, and Week 3

represent the corresponding testing sessions, and the final column (Oxygenation) represents the data from the Oxygenation Group on the final test, specific to the asepsis questions. The mean is higher after Week 1 for each test. The final mean for the asepsis test is higher than the previous 2 tests; however the final mean for the oxygenation test is less than Week 2. A possible cause for higher scores in Week 2 could be the close time frame of testing from the first and second sessions. The final mean scores for the last testing sessions were both 21% higher from the first testing session. The participants in the Asepsis Group scored an average of 21% higher (71% versus 50%) than the participants in the Oxygenation Group. The participants in the Oxygenation Group scored an average of 21% higher (69% versus 48%) than the participants in the Asepsis Group.

Table 1

Descriptive Statistics of Asepsis Scores

	Mean	Median	SD	Range	Minimum	Maximum
Week 1	49	45	13	50	25	75
Week 3	71	70	11	40	55	95
Week 9	71	70	10	35	55	90
Oxygen	50	50	9	35	30	65

Note: Data from each week of testing; Oxygen = mean of asepsis group scores achieved on the oxygenation questions of final test; final mean score on asepsis questions was 71% and the final mean score for the oxygenation questions was 50%

Table 2

Descriptive Statistics of Oxygenation Scores

	Mean	Median	SD	Range	Minimum	Maximum
Week 1	50	50	11	45	30	75
Week 3	73	77	16	50	45	95
Week 9	69	65	13	40	50	90
Asepsis	48	47	8	30	30	60

Note: Data from each week of testing; Asepsis = mean of oxygenation group scores achieved on the asepsis questions of final test; final mean score on oxygenation questions was 69% and the final mean score for the oxygenation questions was 48%.

The project administrator performed a series of paired *t*-tests. For the Asepsis Group, an independent *t*-test was calculated, which showed the *t* statistic of 2.75 was greater than the *t* Critical one-tail of 1.70. The corresponding *p* value of 0.005 showed a statistical significance, and therefore the null hypothesis was rejected. For the Oxygenation Group, a dependent test *t*-test was calculated, showing the *t* statistic of 15.11 was greater than the *t* Critical one-tail of 1.73, and therefore the null hypothesis was rejected. The corresponding *p* value of 0.000 showed a statistical significance.

The project holds a high degree of internal validity, as the participants were randomly assigned to groups. As students entered the room on the first session, each student was given a yellow or blue card, which corresponded to either Group A (Asepsis) or Group B (Oxygenation). Initially, there were 36 students (n=36) in Session 1, one dropped out during the first session due to illness. Of the remaining 35(n=35), 17 students were in the Asepsis Group and 18 in the Oxygenation Group. The mortality effects, or attrition, consisted of four students absent on the last session, exclusively from

the Asepsis Group. The instrumentation was identical for all sessions; the same faculty was present with the project administrator.

External validity was considered weak because the student sample is not necessarily representative of all first semester nursing programs across the United States, as some states may have more ethnically diverse students than represented within this study.

Timeline

The actual project with the students occurred over a period of 12 weeks, Session 2 was held two weeks after Session 1, and Session 3 was held nine weeks after Session 2. Previous meetings with the Chair and the Preceptor (who was the course leader) were held two months before the testing sessions with the students.

Budget

Thirty-eight students were enrolled in the class, therefore 38 Consent forms, 38 Case Study handouts, 14 tests for asepsis, 14 tests for oxygenation, 14 review sheets for asepsis, 14 review sheets for oxygenation, 14 answer sheets for asepsis test, and 14 answer sheets for the oxygenation test were created. Thirty-six students were in attendance; however one declined due to illness before the teaching session began. The project administrator printed the above materials from a personal computer. The cost consisted of a pack of paper for three dollars and the ink used in the printer, approximately $10.

Limitations

The proposed project design was carried out as originally intended, therefore, no deviations were necessary.

Summary

The project purpose was to compare the final mean scores from a group of first semester nursing students, in which two groups had separate topics that were tested and reviewed (asepsis and oxygenation). The convenience sampling by a randomly assigned process was from a small university in the United States. After the three sessions of testing, data was collected on each test, the scores obtained from the asepsis, and oxygenation tests and scores obtained from each group on the specific topic from the final cumulative test. After obtaining consent, conducting the Case Study activity with the entire class, the two groups were given tests, and then time was allowed to review correct answers as well as review the other topic from a pre-made review sheet. The final session consisted of all of the questions from both individual tests. The data were analyzed using independent and dependent *t*-tests using Data Analysis on Excel 2007. Descriptive statistics and paired t-tests were computed for the two groups. Statistical significance was shown present for each group, $p < 0.001$.

CHAPTER IV

Results

This project examined the outcome scores of nursing students after sessions of an initial testing was implemented by two case studies, followed by testing and studying on the two topics. It was a replication of a study performed with medical residents for examination of final scores after testing and study sessions, given the name of *Examining nursing students' retention of taught content by repeat study and repeat testing: a replicated study*. It was implemented to present the additional learned information to the body of nursing knowledge.

Sample Characteristics

The initial sample size consisted of 38 students enrolled in the class. On the first testing day, 36 (n=36) were present and signed consents to participate in the study. One withdrew before the testing started due to illness. In the asepsis group, 17 students participated in the first and second tests; four students were absent for the third testing, leaving 13 participants. In the oxygenation group, 18 students participated in each testing session. Table 3 presents the number of students for each testing session.

Table 3

Number of Students for each Testing Session

Week	Asepsis Group	Oxygenation Group	Total
Week 1	17	18	35
Week 3	17	18	35
Week 9	13	18	31

Note: The total number of participants was 35 for Week 1 and 2 (*n*=35) and Week 3 had 31 (*n*=31).

Major Findings

Thirty-five students signed consents to participate in the study, and 31 completed the final testing session. Initially, 17 were in the asepsis group and 18 were in the oxygenation group. After a third repeat of the tests, the final tests for both groups showed an average of 21% higher scores than the initial test. Table 4 shows the mean results and *p* values from the initial and last tests. The second week was higher than the first testing session, showing an average increase of 21% for the Asepsis Group and an average increase of 23% increase for the Oxygenation Group. The second week for the Oxygenation Group showed a slight decrease in the scores of 4%. The third week for the Asepsis Group showed a mean score equal to the second testing session of 71%. The third week for the Oxygenation Group showed a mean score of 4% less than the second week of 68%. On the final test, the scores for both groups scored on average 22% and 18% higher: The asepsis final test had a mean of 71% versus the initial mean of 49%; the oxygenation final test had a mean of 69% versus the initial mean of 51%.

Table 4

Mean Results of the Tests

Week	Asepsis mean	Oxygenation mean	*p* value
Week 1	49	51	0.01*
Week 3	71	73	
Week 9	71	69	0.000*

Note: *Significant at the $p<0.05$ level

Figure 2 displays the graphical representation of the averaged results of the asepsis and oxygenation tests over the nine week period. Both graphs show an increased score for the second week and either the same or a slight decrease on the final week.

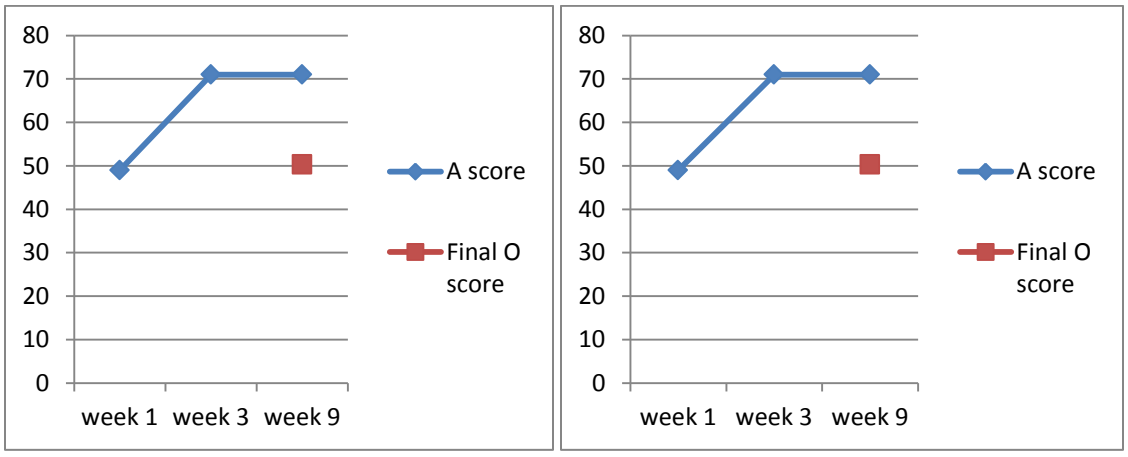

Figure 2. Graphical representation of the averaged results for the (a) asepsis and (b) oxygenation tests over the 9 week period. Test 1 was administered immediately after the Case Study activity. Tests 2 and 3 were administered at Week 3 and Week 9 intervals. A = Asepsis; O = Oxygenation

Summary

Two tests with the topics specific to asepsis and oxygenation were administered to 35 students. The participants who completed all three tests showed an average of 18% to 22% increase in scores from the first to final tests. Scores were lowest for the first test, highest on the second test and even though a slight decrease showed on the last test, the final scores were higher than the initial tests.

CHAPTER V

Discussion

The results of this project, *Examining nursing students' retention of content by repeat study or repeat testing*, showed that the students who repeated testing had a higher mean of scores than the activity of repeated study, known in the literature as the testing effect. This project supports current literature that repeated testing produces higher scores. The original study showed higher scores initially and on the last tests, with lower scores on the second test. This study showed the opposite, higher scores were produced at the second test for both groups. The project administrator speculates the higher results could have been due to the closeness of the second testing occurring two weeks after the first. The last testing produced scores higher than the initial tests.

Implications of Findings

The findings of the project are important for nursing faculty so to intentionally incorporate more testing in the classroom to promote longer retention of content. The increase of the scores from Week 1 to Week 3 show that retention has occurred and the same or slight decrease to Week 9 shows that retention had been maintained and was higher than Week 1. In comparison to the original study with medical residents, the scores from that study were higher on Week 1 versus Week 2, and a possible cause may be that the residents were currently in school, while the nursing students were in the first course of the nursing curriculum. If this study was conducted with second year nursing students, a similar result of corresponding scores may have occurred as in the original study, possibly due to the maturity of students within the program. Nursing curricula contain considerable content and faculty are anxious to learn methods to successfully

incorporate the large amount of content into the allotted time frame, while supporting students' learning that assists them to apply the content to be successful on the NCLEX examination. This project and the presented literature are consistent with the practice of testing more often, even with a delay between the testing, to enhance and increase testing scores.

It should be noted that the sessions of review after each test may not be typical for a nursing student. Students were allowed to individually review the questions, the answers, and given the opportunity to review the study sheet. Some students did not spend extensive time in looking at the review sheet, whereas one student took a picture of the review sheet with her cell phone. No specifics instruction had been provided that prohibited taking pictures, but for future studies, it is recommended that picture taking should not be allowed. The methods that students have available to review tests can vary in institutions, and the individual experience for this project may not be the best method to promote optimal learning for these students.

Nursing educators want students to perform well in school and transfer that success when taking the NCLEX exams. Understanding better methods to facilitate student learning is crucial to the classroom experience. Educators interested in the study behaviors of students can utilize the repeating testing method to produce applicability of knowledge, and not just for remembrance for a particular test (Schuwirth & Van Der Vleuten, 2004).

Application to Theoretical/Conceptual Framework

The results of the study provided support to Pender's Theory of Health Promotion. The middle range theory of Retention of Content was measured and found to

have increased during the last testing session. As the literature suggested, students may not be aware of how this method benefits their outcomes. The students in this project would have had to have an additional session to explain the results of the higher scores. Pender's Theory proposes the changed behavior by a perceived higher self-efficacy and a behavior change in study habits.

Limitations

There are limitations that need to be considered in light of the findings. First, the same test questions were used during each session, which could account for a remembrance of the answers. Second, the students knew they were not getting a grade for the tests and may have not applied their upmost ability. Third, the sample was small and limited to the one class of students. Lastly, because students reviewed individually, the lack of collaborative discussion on questions or the study sheets may have not initiated the best atmosphere for learning for some students. A measure was not taken on how much study occurred on the review sheets.

Implications for Nursing

The results of this study have several implications for nursing education. The first is the project adds to the literature of education and presents options for nursing education that alternative methods of learning can be a productive means to what is desired in a nursing curriculum. Secondly, nursing students will benefit from the study, providing evidence that a repeat of testing can enhance their long-term retention. A third implication is the emphasis that testing should be used for learning as well as assessment. Finally, more investigation is warranted for class and testing sessions and the effect on clinical application.

Recommendations

Further investigation into other nursing courses could benefit faculty and students to determine the effect that testing has on final scores and clinical performance. The immense reading that is required in nursing school is a challenge for students, and the use of testing interdispersed with the reading assignments could be explored (Wissman, Rawson, Pyc, (2011). Another factor found in the literature was the practice of students rereading or rewriting notes, which consumes much time (Karpicke et al., 2009). If students are aware of a better method of learning and retaining the information, they will be better able to manage the large amount of information that must be mastered.

Utilizing the testing effect across different classes, a larger pool of participants and various levels of a nursing curriculum would be beneficial to further evaluate data that the testing effect is an enhancement to student learning. Nursing education contains a broad range of subject matter, so a measuring of a particular subject's testing effect data across geographical locations would broaden the knowledge of this concept.

Conclusion

Test scores from nursing students at this project's completion were examined and provided data on the effectiveness of the testing sessions versus the study only sessions of the two topics. Of the two initial hypotheses, one was met, which showed that a repeat test produced higher scores than a repeat study. The resulting outcome desired was evidence that enhances nursing students to be safe and knowledgeable clinicians, as well as meeting the academic and accreditation requirements of the educational institution. Providing the results of the repeat testing benefit to faculty and students may produce more confidence in utilizing testing within and outside of the classroom, improve

retention of content, and improve overall scores and behavioral outcomes of nursing students.

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Appendix A

Agenda for Teaching Case Study Lesson

0800-0810 –Students are given yellow or blue index card randomly as they enter the classroom. Yellow cards are for group A students and blue cards are for group B students. Students will write their names on the cards. Students will be given the consent form, the project facilitator will read the consent and collect after students have signed the forms.

0810-0815—Students will be asked to gather into groups of 5, which will consist of 8 groups.

0815-0830--Students will be given a one page Case Study on Asepsis, and the project administrator will read it out loud. Students will be instructed to answer all the questions as a group. Books may be used. Students will be told to formulate their answers so to answer in 2 minutes or less.

0830-0845—Each group will be asked by the project administrator to answer one question. Each group will have no more than 2 minutes to answer the question.

0845-0900-- Students will be given a one page Case Study on Oxygenation, and the project administrator will read it out loud. Students will be instructed to answer all the questions as a group. Books may be used. Students will be told to formulate their answers so to answer in 2 minutes or less.

0900-0915-- Each group will be asked by the project administrator to answer one question. Each group will have no more than 2 minutes to answer the question.

0915-0920—Students with yellow cards will sit on one side of the room, students with blue cards will sit on the opposite of the room

0920-0940—Students will take a 20 question test; Group A will take Asepsis test, Group B will take Oxygenation test.

0940-0950—Tests will be collected; Tests answers handout for the specific test taken will be distributed and a review sheet on the other topic will be given so that both can be reviewed.

0950 – All test answers and review sheets will be collected. All yellow and blue index cards will be collected.

Appendix B

Informed Consent

Examining nursing students retention of taught content by repeat study and repeat testing:

A replicated study

Project Title and Purpose:

You are invited to participate in a research study entitled Examining nursing students' retention of taught content by repeat study and repeat testing: a replicated study. This is a study to examine how people retain information after studying and testing.

Investigator(s):

This study is being conducted with students in a Fundamentals Nursing class at _____ as part of a class project under the direction of _____, School of Nursing.

Description of Participation:

In this study you will be given a 1 hour presentation on a pre-chosen content, and then asked to study and take a short test.

Length of Participation

Your participation in this project will take approximately 3 hours. If you decide to participate, you will be one of approximately50 participants in this study.

Risks and Benefits of Participation:

There are only minimal risks associated with participation in this project. The participation is voluntary, and allows you to an experience in learning content and testing. The students will be taught as a group, and will test individually; there will be no competition involved. The student's class instructor and the project facilitator will both be present ensuring that students feel comfortable with the learning and testing environment. Should a participant experience any emotional stress due to the teaching session, review or taking a test, I will remind all participants that they are free to leave the room at any point during the study. If the whole group experiences emotional stress, the facilitator will ask if anyone would like to leave the study. I will stop any of the sessions if the group begins to feel uncomfortable. The university's counselor will be available as needed at the phone number of _____ at the _____, or the _____ 24-Hour Crisis Line at _____. The benefit of participation in this study is the knowledge you will gain about the topic being investigated. You may receive a

complete description of the study when you are finished participating, if you so desire. The results of the study will only be used for the researcher's class project. You may obtain a copy of all results by contacting me any time after _____. You will not receive financial reimbursement for your participation.

Volunteer Statement

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to be in the study, you may stop at any time. You will not be treated any differently if you decide not to participate or if you stop once you have started.

Confidentiality:

All information you provide will be kept confidential. Letters signifying Group A and Group B, will be used as identification, no names will appear with the data. All data files will be destroyed at the end of the project.

Fair Treatment and Respect:

(Institution) wants to make sure that you are treated in a fair and respectful manner. Contact the University's Institutional review Board at _____ if you have any questions about how you are treated as a study participant. If you have any questions about the project, please contact _____, professor at (institution).

Participant Consent:

I have read the information in this consent form. I have had the chance to ask questions about this study, and those questions have been answered to my satisfaction. I am at least 18 years of age, and I agree to participate in this research project. I understand that I will receive a copy of this form after it has been signed by me and the researcher.

_____ _____ _____

Participant Name Participant Signature DATE

(PLEASE PRINT)

_____ _____

Project Administrator Date

Appendix C

Case Study of Asepsis and Oxygenation

ASEPSIS CASE STUDY

Mrs. Smith is an 80-year-old woman who is independent and has lived at home alone since her husband died 3 years ago. She developed a cold and tried to treat it with over the counter medications and home remedies. Feeling much worse, she went to her physician, who suspects she has pneumonia and is transferred into the hospital. In the history assessment, the nurse learns that Mrs. Smith has felt too weak to cook and clean, has lost 10 pounds in the last month and has a persistent cough. Her temperature is 101.5°F and she says "I want this cough to stop, it makes my whole body hurt!". She then asks "Where is your smoking patio?".

ORDERS:

1. Oxygen 2 liters by nasal cannula
2. Codeine, 1 teaspoon every 4 hours as needed for cough
3. Antibiotic IV every 8 hours
4. Ambulate with help to the bathroom

Questions:

1. What data supports Mrs. Smith's risk for infections? What additional questions would you ask about her history?
2. What type of precaution will be initiated for Mrs. Smith and why? Why would the other types not be appropriate?
3. What can you do to prevent the spread of infection to herself and others?
4. If a diagnosis of pneumonia is confirmed, demonstrate how you would use PPE to help her to the bathroom.
5. A sterile field needs to be set up to place a dressing on her knee. Demonstrate how this would be set up and discuss the principles of sterile technique.
6. What types of activities could you discuss with Mrs. Smith when she returns home to promote her health?
7. Mrs. Smith is told she has a nosocomial infection. How would you explain this to her and what would be your actions for the rest of her hospital stay?
8. Which of Mrs. Smith's problems is the highest priority? Explain your reasoning.

OXYGENATION CASE STUDY

Mr. Jones is an obese 60-year-old man who had abdominal surgery two days ago. When asked about his daily routine, he states he sits behind a computer most of the day and eats his dinner in front of the television. He usually falls asleep in his recliner chair. His history shows he has a history of bronchitis and he says "I get it every year". His wife has brought his CPAP machine to the hospital room and says "You better wear this thing!".

ORDERS:

1. Antibiotic every 8 hours
2. 1800 calorie diet
3. Ambulate in hallway 3 times per day
4. CPAP machine to be used during any hour of sleep

Questions:

1. What factors contribute to Mr. Jones current condition and his history of bronchitis each year?
2. How would you respond to the wife's statement of "You better wear this thing!" regarding Mr. Jones CPAP? What type of breathing pattern do you suspect Mr. Jones has for the CPAP to be prescribed? Demonstrate it to the class.
3. What other assessment questions would be beneficial to ask Mr. Jones?
4. Mr. Jones has now been prescribed to wear 2 liters of oxygen at home upon discharge. Role play the teaching you would provide for him (one student be Mr. Jones and two students be the nurses who teach him.)
5. You instruct Mr. Jones how to use an Incentive Spirometer. Explain what it is and what it does and how to use it.
6. Mr. Jones is going to be discharged with a Glucocorticosteroid medication, called Flovent. Role play as the nurse to Mr. Jones and provide instructions on how to use this medication.
7. What specific suggestions can you make to Mr. Jones about his activities of daily living to help improve his overall health?
8. Which of Mr. Jones problems is the highest priority? Explain your reasoning.

Appendix D

Review Sheets for Asepsis and Oxygenation

Definitions ---

1. Infection – invasion of microorganisms
2. Virulence – microorganism ability to produce disease
3. Communicable disease – transmittal of infection to an individual via direct/indirect or airborne
4. Opportunistic pathogen – causes disease only in a susceptible individual
5. Asepsis – freedom from disease-causing microorganisms
    a. Medical asepsis – confines a specific microorganism to a specific area, limiting the number, growth and transmission of microorganisms; clean – absent of almost all organisms; dirty – likely to have microorganisms that can cause infection
    b. Surgical asepsis, Sterile Technique – free of all microorganisms
6. Sepsis – state of infection, such as septic shock

Types of Microorganisms Causing Infections

1. Bacteria – infection causing microorganism causing disease and can be and can be transported by air, water, food, soil, body tissues & fluids, inanimate objects; can infect skin, nasal passage, mouth, intestine, urethral, urethra and vagina (staph)
2. Viruses – consist of nucleic acid and enter living cells in order to reproduce (common cold)
3. Fungi – yeasts and molds (Candida Albicans)
4. Parasites – live on other living organisms (mites, fleas, ticks)

Types of Infections

1. Local – limited to specific part of body
2. Systemic – microorganisms spread & damage parts of body
3. Bacteremia – microorganisms in blood
4. Septicemia – Bacteremia results in systemic infection
5. Acute – appear suddenly, short lasting
6. Chronic – occur slowly, long term

Nosocomial -

1. Nosocomial – originates in hospital; before or after stay
2. Health care-associated infections (HAI) – originate in any healthcare setting
    a. 33% urinary track
    b. 22% surgical wounds
    c. 15% respiratory track
    d. 14% blood stream
3. Endogenous source – from client themselves
4. Exogenous source – from hospital facility or personnel
5. Iatrogenic infections – result from diagnostic/therapeutic procedures

6. Compromised host – at increased risk (illness, surgery)
7. Hand hygiene most important

Chain of Infection

1. Portal of exit and entrance
2. Transmission – mode of transfer to another
    a. Direct – direct contact, droplet
    b. Indirect
        i. Vehicle-borne - intermediate means via portal entry (inanimate object)
        ii. Vector-borne – animal or insect
    c. Airborne – droplet transmission (tuberculosis)
3. Susceptible host – person at risk for infection (age, immunity, transplants)
4. Bloodborne pathogens – organisms in blood
5. Standard precautions (SP) – consists of handy hygiene, personal protective equipment (PPE); used for all clients; applies to blood, all body fluids, secretions and excretions, nonintact skin, mucous membranes
    a. PPE
        i. Gloves – protect hands; reduce likelihood of transmitting microorganisms from nurse or other clients
            1. Latex allergy – local or systemic; reaction to balloons, condoms; use hypoallergenic
        ii. Gowns – protects staff's uniform
        iii. Face mask – reduce risk for transmission by droplet and airborne
        iv. Eyewear – protect face and worn over glasses
        v. Single use supplies are disposed, linens bagged
        vi. Equipment – disposable or cleaned
        vii. Transporting clients – all wounds covered, facility protocol

Defenses

1. Nonspecific defenses
    a. Anatomical & physiological barriers
        i. Skin – bacteria plentiful in moist areas
        ii. Secretion – acidic inhibits bacterial growth
        iii. Respiratory – nares with cilia; lungs with phagocytes
        iv. GI – mouth saliva with inhibitors; stomach acidity; flora of large intestine; peristalsis
        v. Eye – tears
        vi. Vagina – pH of 3.5 – 4.5
    b. Inflammatory response
        i. Inflammation – local/nonspecific reaction to injury/infectious agent (pain, swelling, redness, heat, impaired function)
            1. Physical – mechanical objects (heat, cold, radiation)
            2. Chemical – external irritants (acids, poisons, gases)
            3. Microorganisms – bacteria, viruses, fungi, parasites
2. Specific defenses

a. Antibody-mediated - humoral immunity with B lymphocytes
b. Antibodies – attack bacterial & viral infections
c. Active immunity – antibodies produced in response to natural antigens (infectious microorganism, vaccines); B cell may produce IgM, IgG, IgD, IgE
d. Passive immunity – natural or artificial antibodies (nursing mother, immune serum)

Susceptibility factors

1. Age- newborns protected 2-3 months; immunizations start at birth; elderly weakened immunity
2. Heredity – genetic susceptibility (deficiency in immunoglobulins)
3. Level of stress – blood cortisone elevation decreases anti-inflammatory response
4. Nutritional status – protein needed (antibodies are proteins)
5. Current medical therapy – radiation kills good and bad cells; anti-inflammatory meds inhibits; antibiotics may kill normal flora
6. Preexisting disease processes – chronic conditions (pulmonary, vascular diseases, immune conditions, diabetes)

Nursing Management

1. Assessment
    a. History
        i. Immunizations
        ii. Tuberculin skin test
        iii. Past infections
        iv. Medications and vitamins
        v. Diagnostic/therapies
        vi. Past surgeries
        vii. Eating habits/nutrition
        viii. Stress in life
        ix. Changes in health
    b. Physical exam – check body specific symptoms, open wounds, labs & cultures

2. Planning
    a. Restore defenses; avoid spread of infectious organisms; reduce problems with infection
        i. Clean, disinfect, sterilize
            1. Antiseptics – inhibit growth of some organisms
            2. Disinfectants – destroy pathogens other than spores; chemical used on skin/tissue
            3. Sterilization – destroys all pathogens
        ii. Change dressings when soiled
        iii. Cover mouth with coughs/sneezes
        iv. Wear gloves when needed
        v. Use sterile technique as needed

1. Operating rooms, injections, wound dressing changes, urinary catherizations, IV therapy)
2. Must not be touched by unsterile objects
3. Avoid prolonged exposure to airborne microorganisms
4. Fluids should flow in direction of gravity
5. Prevent sterile drapes from moisture
6. Edges of sterile field are unsterile
7. Skin is not sterile (use gloves, forceps)
8. Maintain vigilance in protecting sterile field
9. Sterile gloves & gown; prevent contamination & transmission

vi. Ensure proper nutrition, immunizations, respiratory exercises, stress management, sleep, fluids, sleep

vii. Use Standard Precautions

1. Isolation – prevent spread of infections to all
    a. Assess psychological needs, communication, use least restrictive precautions
2. Transmission-Based – used with known/suspected infections spread by airborne, droplets, or contact
    a. Airborne - < 5 microns (measles, rubeola, tuberculosis)
    b. Droplet - > 5 microns (mumps, pneumonia)
    c. Contact – direct contact (C.difficile, E.Coli)

b. Assess family's home environment before discharge (bedding, visitors, infection control practices

i. Hand hygiene with food, touch; shared items; cleaning products;

ii. Prevention of nosocomial infections – hand hygiene, nails & jewelry; transmission prevention

iii. Wound care management

iv. Referrals

c. Promote infection control

i. Occupational safety & Health Administration (OSHA) – regulations to protect healthcare workers from occupational exposure

ii. Occupational exposure – employee contact with potentially infectious materials or blood to skin, eye, mucous membrane or parenteral contact

iii. Exposure incident

1. Wash punctured area with soap/water; flush mucous membranes with saline/water for 5-10 minutes
2. Report incident immediately to supervisor
3. Seek treatment and/or evaluation and follow-up
    a. HIV Exposure – treatment started within hours; HIV titers
    b. Hepatitis B – Titer after series or HBIG/Hep B within 1 – 7 days

c. Hepatitis C – Anti-HCV and ALT at baseline and 4-6 months after exposure

4. Complete incident report per agency protocol

d. Infection Control Nurse
   i. Monitors/trains employees on infection prevention
   ii. Monitors infection events

Factors affecting Respiratory Function

1. Age –
   a. chest walls rigid
   b. decreased cough reflex, cilia, immune system
   c. Gastroesophageal reflex disease (GERD) increases risk of aspiration
2. Environment –
   a. Higher altitudes > lower PO2
   b. Air pollution, exposure to smoking
3. Lifestyle –
   a. Lack of physical exercise
   b. Occupations – sandstone blasters, asbestosis, agricultural agents
4. Health status – diseases of respiratory system can affect oxygenation of blood
5. Medications –
   a. Decrease respiration – sedatives, antianxiety drugs, barbiturates, narcotics
6. Stress – sympathetic nervous system stimulated; hyperventilation

Alterations in Respiratory Function

1. Patency –
   a. Adventitious breath sounds – abnormal breath sounds
   b. Stridor – harsh, high-pitched sound
2. Air movement –
   a. Tachypnea – rapid (fever, metabolic acidosis, pain, hypoxemia)
   b. Bradypnea – abnormally slow (drug ingestion, metabolic alkalosis, brain injury)
   c. Apnea - absence of breathing
   d. Hypoventilation – increase of carbon dioxide (hypercarbia or hypercapnia);
      i. Hypoxemia – low level of oxygen
   e. Hyperventilation – increased movement of air; more CO2 eliminated
      i. Kussmaul's breathing – body compensates for increased CO2
   f. Abnormal breathing patterns
      i. Cheyne-Stokes – shallow to deep with periods of apnea
      ii. Biot's – shallow breaths interrupted by apnea
      iii. Orthopnea – must be in sitting or standing position to breath easily
      iv. Dyspnea – Shortness of breath (SOB)
   g. Conditions affecting diffusion and transport
      i. Hypoxemia – reduced oxygen level in blood
      ii. Hypoxia – insufficient oxygen throughout body; causes cellular injury/death

iii. Cyanosis – bluish discoloration in skin, nail beds, mucous membranes
iv. Congestive heart failure & hypovolemia – decreased cardiac output limits body's ability to compensate for hypoxemia

Nursing Management

1. Assessment
    a. History
        i. History of and current problems – colds, pneumonia, asthma, tuberculosis, SOB, aggravating activities, cough
        ii. Lifestyle – smoking, occupation
        iii. Sputum – color, thickness, blood-tinged
        iv. Chest pain – pain with breathing, occurs in cold, occurs with inspiration or expiration, factors that cause or relieve it
        v. Risk factors – family history, weight, diet, activity
        vi. Medications – OTC meds, prescriptions

    b. Physical exam – inspection, palpation, percussion, auscultation
        i. Rate, depth, rhythm, quality, symmetry
        ii. Shape, presence of barrel chest
    c. Diagnostic studies
    d. Sputum specimen, throat cultures, arterial blood gases (ABGs), pulmonary function tests (measure lung volume/capacity)
2. Planning
    a. Promote oxygenation - positioning, ambulation, clean air,
    b. Deep breathing & coughing – removes secretions; pursed lip-breathing increases oxygen levels
    c. Hydration – fluid intake, humidifier
    d. Medications –
        i. Bronchodilators – reduce bronchospasm, open airways; inhaled, oral, IV
        ii. Anti-inflammatory – glucocorticoids, decrease edema & inflammation; inhaled, oral, IV; used for preventative, not acute attacks; side effects: increased heart rate, tremors; report adverse side effects: hoarseness, throat infections
        iii. Leukotrine modifiers – suppress leukotrienes on smooth muscle (leukotrienes cause bronchoconstriction, mucous, & edema)
        iv. Expectorants – break up liquid and expectorate;
            1. Guaifenesin – common expectorant in cough syrups
            2. Codeine – suppressant used during sleep
    e. Incentive Spirometry – improves pulmonary ventilation; counteracts effects of anesthesia, loosens secretions, expands collapsed alveoli
    f. Percussion, Vibration, Postural drainage –
        i. Percussion – forceful striking with cupped hands to dislodge secretions from lung walls

   ii. Vibration – done by shaking hands up/down over area on exhalation
   iii. Postural drainage – gravity using various positions after given bronchodilator; avoid shortly after meals

g. Mucus Clearance Devices (MCD) – Flutter device contains steel ball that moves upon exhalation into device, causing loosening of mucus to be expectorated
h. Oxygen Therapy –
   i. Considered medication, is prescribed liter flow per minute (L/min)
   ii. Humidifiers prevent drying of mucous membranes
   iii. Caution about danger of smoking while in use
i. Oxygen delivery systems -
   i. Cannula – 2-6 L/min; can eat & talk; inexpensive
   ii. Face mask –
      1. Simple – 40-60% at 5-8 L/min; covers mouth & nose
      2. Partial rebreather - 40-60% at 6-10 L/min; reservoir bag attached allows partial recycled expired oxygen for rebreathing; bag must not totally deflate or CO2 will buildup
      3. Nonrebreather – 95-100% at 1-15 L/min; highest concentration; one-way value prevents room air or client's exhaled air from entering bag to allow only oxygen inspired; CO2 is prevented by bag not being totally deflated
      4. Venturi – 24-50% at 4-10 L/min; administers precise concentration
      5. Face Tent – used when masks are not tolerated
   iii. Noninvasive Positive Pressure Ventilation (NPPV)
      1. Continuous positive airway pressure (CPAP) – used for acute & chronic respiratory conditions to enhance airflow; ensure client's use as directed
j. Artificial airways
   i. Keeps upper air passges oen when obstructed by secretions or the tongue
   ii. Easy to maintain and low risk of complicatitons
   iii. Used for clients with altered leels ov consciousness
   iv. Side lying position allow secretions to drain
   v. Device is not taped in place and removed when client begins coughing
   vi. Mouth care should be performed every 2-4 hours

k. Suctioning
   i. Suction machine that has tubing and a catheter connected that allows suctioning of secretions.
   ii. Oral tube for suctioning – Yankauer

iii. Can be done sterile or non-sterile depending on client's type of airway

3. Evaluation
    a. Nurse will evaluate if goals are met and respirations are unlabored and within expected range
    b. Evaluate if client is taking medications and performing treatments as prescribed
    c. Evaluate if client is able to control psychological stress level if breathing problems exist
    d. Evaluate if client can perform ADLs (activities of daily living)
    e. Evaluate if nutritional needs are being met

Appendix E

Debriefing statement

Thank you for participating in this research study on nursing students' learning and testing. Written question test items were used all the participants in this study. The goal of the review sheets and tests was to gather information on nursing students learning and testing in regards to both methods of learning. Whether a nursing student prefers to study versus answering test questions, it was hypothesized that testing would positively correspond with higher tests grades over a span of time. If you would like to learn more about testing and retention of learned content, please contact me and I will provide you with resources.

Your participation was important in helping this project administrator to expand this body of knowledge.

Final results will be available from the project administrator, _____, by (date) . You may contact me to receive an email copy of the final report. All results will be grouped together; therefore individual results are not available. Your participation, including your name and answers, will remain absolutely confidential, even if the report is published.

If you have any additional questions regarding this research, please contact me:

(project administrator name) Email: (email address)