

OUTCOMES OF TEACHING BACCALAUREATE NURSING STUDENTS ABOUT
MASTITIS UTILIZING A MULTIMODAL TEACHING TOOL

By

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Abstract

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Experiencing mastitis during breastfeeding can be a painful and frightening experience for a mother. Further complications of septicemia, abscesses or the complete removal of a breast have been known to interrupt this natural phenomenon of infant breastfeeding. Several factors influence the variations in reports of 10-33% incidence of mastitis, however, the underreported cases maybe the most significant effect. Such underreporting has devalued the actual incidence among women, limiting the priority of its inclusion in postpartum teaching by nurses. Another factor to consider is that the majority of literature reviewed for this study and used in educating students and practicing nurses lacks current evidence based anatomy and physiology of the breast during lactogenesis as well as the pathophysiology of mastitis. This, in combination with traditional teaching methods, ill-equips the nurse to educate the new mother. Current studies on cognition support the use of multimodal teaching tools to maximize student learning. Using current evidence-based information, this study compared the knowledge acquired and retained regarding postpartum mastitis utilizing single traditional teaching methods and a 22 minute multimodal learning video on mastitis to baccalaureate, undergraduate nursing students. The results of this study highlight a significant difference in knowledge acquisition after viewing the

designed multimodal teaching tool. An overall increase is also noted in the student's self-reported confidence and comfort level in explaining and caring for a woman with mastitis. Baccalaureate student nurses were able to better articulate a description and treatment of mastitis to a new mother as well as to other health care professionals in medical terminology. These results may influence the future developments of multimodal tools in universities, increasing the cognition of nurses in educating and preparing patients about their health care needs.

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Chapter 1 – Introduction

Statement of the Problem

Mastitis during breastfeeding can be a painful and overwhelming event leading to unanticipated physical, financial and psychological outcomes for a mother and child. During a recent interview with patients who have experienced mastitis, one mother described it as “a painful, horrible experience....like being run over by a semi-truck” (Gail Peterson, ARNP, IBCLC, 2009).

Evidence-based studies indicate that these occurrences are common in approximately one-third of mothers during the breastfeeding course, often going unreported in the medical community (Riordan, J., 1990; Fetherstone, C., 1998; Foxman, B., Schwartz, K., & Looman, S., 1994).

Limited awareness of the frequency of mastitis is due to the prevalence of women who do not require hospitalization, woman who self-treat their symptoms successfully, or those who are treated over the phone by their primary care providers (Lawrence, R. 2005). Nonetheless, the severity of this illness ranges from a benign, self-limiting infection with no systemic symptoms to the formation of an abscess or total septicemia (Foxman, B., D’Arcy, H. Gillespie, B., Bobo, J., Schwartz, K., 2002). Extensive mastitis may also lead to surgical interventions or removal of the breast. Any changes in the breast combined with frustration and the threatened ability to breastfeed can lead the mother into a sense of failure and result in early cessation of nutritious breast milk to the infant (Riordan, J. 2005).

As of 2005, the *Healthy People 2010* goal of 50% of mothers in the United States continuing to breastfeed at 6 months, and 25 percent at 12 months postpartum has not been met. The percentage of infants who continued to exclusively breastfeed was 39% at 6 months and 20 percent at 12 months, (http://www.cdc.gov/breastfeeding/data/NIS_data/2005/age.htm). The duration of

breastfeeding has been shown to be affected by the mother's personal choice to continue as well as the healthcare provider's ability to teach, support and provide guidance during breastfeeding complications, including mastitis (Spencer, J., 2008). At this time, two problems exist within the healthcare environment that hinders the prevention of mastitis and its effects on early cessation of breastfeeding. The first problem is the limitation of effective teaching tools and strategies available to educate healthcare workers on this subject. The second, more troublesome problem, is the inconsistent data published and utilized by students and professional healthcare workers on the pathophysiology of mastitis. These two issues are major obstacles in providing ongoing optimal preparation to nursing mothers.

Learners, including healthcare providers, may have limited retention of key knowledge taught in traditional classroom settings due to the severe capacity limit of attention and memory (Fougnie, D., Marois, R., 2006). Cognitive overload is when the "learner's intended cognitive processing exceeds the learners intended cognitive capacity" (Mayer, R., Moreno, R., 2003, pp.43). Traditional teaching methods are generally teacher-directed learning utilizing unifocal tools for activities or demonstrations during lectures. New research on cognitive science has discovered that this approach often limits students from retaining valuable skills or absorbing a working knowledge of the lesson beyond the end of the session (Udovic, Morris, Dickman, Postlethwait and Wetherwax, 2002). Meaningful learning, therefore, must be sensitive to cognitive load abilities of the student. Current technological advances utilizing functional Magnetic Resonance Imaging (MRI) scans "confirm a dual coding system through which visuals and text/auditory input are processed in separate channels" (Fadel, C., 2008, pp.3). With this new knowledge, studies have shown that using a multimodal approach to learning is superior to unimodal strategies. Learning and retention is deeply enhanced and augmented as students use well-designed combinations of

visuals, auditory and texts through such avenues as animations, interactive illustrations, narration, charts, or video. Today's in-depth understanding of cognitive science describes the limitations of traditional learning methods that are still used in colleges and universities throughout the world. These findings also challenge universities and faculty to redesign their teaching strategies based on the principles of differentiated learning and incorporating multimodal techniques (Fadel, C., 2008). With this in mind, nurses and healthcare providers may be better qualified using these advanced and effective strategies when preparing new mothers about postpartum complications, including mastitis.

Another problem noted above which affects the incidence of benign and infectious lactation mastitis is the lack of evidence-based information on the subject being available and taught to nursing students and other healthcare providers. A review of ten nursing and obstetrical textbooks published and used from 1980-2007 revealed that for nearly 27 years, nurses, nurse midwives, and physicians have been instructed about breast anatomy, physiology and lactation complications using dated information that lacked in detail and accuracy (Appendix A). In order to reduce the incidence of mastitis, it is vital for nurses to teach accurate, up to date, evidence-based information about post partum complications, in particular on the development of mastitis for breastfeeding mothers. Despite the availability of this new information from current evidence-based research, the potential causes and initial onset of symptoms of mastitis are frequently overlooked by breastfeeding mothers (Fetherston, C., 1998). The basis for this limitation of knowledge in breastfeeding mothers may originate from outdated materials or ill-equipped provisions by the postpartum nurse. This is a critical factor to consider when discussing the causes and frequency of unanticipated and disruptive cases of mastitis among breastfeeding women.

Students engaged in teaching strategies that incorporate multimodal learning designs surpass and outperform students that learn utilizing traditional single modal approaches (Fadel, C., 2008). Consideration of this concept in preparing healthcare providers may enhance our understanding of factors that impact patient outcomes. Using a multimodal design for learning, combined with current evidence based research may be a strong tool in preparing healthcare workers to effectively teach breastfeeding women about the postpartum complications of mastitis.

Statement of the Purpose

The purpose of this study is to compare knowledge acquired and retained regarding postpartum mastitis utilizing a single traditional teaching method at two points in time and a 22 minute multimodal learning video on baccalaureate undergraduate nursing students.

Conceptual Framework

The framework for this study is based on several cognitive learning theories. These learning theories focus on the mental processes and activities that the learner experiences internally. More specifically, the information–processing theory concentrates on human memory and its three areas of “stores” being sensory memory, short-term (or working memory) and long-term memory. Information sensed, passes through each of these phases to hold information and process data received into cognitive long-term memory (McEwen, M., & Wills, E., 2007). It is assumed that effectively stored knowledge from the student can be drawn from when teaching patients about post-partum complications. External stimuli trigger the internal process concerned with learning, remembering and performing. Neuroscientists support this learning theory with supporting evidence for the three types of memory (Fadel, C., 2008). These findings are especially important when researching the efficacy of teaching students with single-mode (unimodal) and multiple-mode (multimodal) tools. Teaching strategies can be designed to have a single method for teaching, such

as an auditory lecture or a visual reading assignment. A multimodal teaching design would incorporate visual, verbal, and auditory stimuli together in teaching the intended subject.

It is important to also consider principles of multimedia design from cognitive multimedia learning theorists when providing a foundation for this study. The main principle of multimedia learning is that “retention is improved by words and pictures rather than through words alone” (Fadel, C., 2008, pp.12). Five major principles of using multimedia have been established and tested on students for classroom comprehension (Mayer, R. 1997). These principles draw from several theorists and were considered when designing the multimodal tool that was tested (Appendix B).

In multimedia learning, the student uses the three cognitive processes of selecting, organizing and integrating the incoming information, and then makes connections between the verbal and visual models (Mayer, E., & Moreno, R., 1998). This concept is further influenced by Paivio’s dual coding theory in which visual and verbal information processing systems have two separate channels for processing information (Mayer, R., 1997). One of the benefits in understanding dual coding in multimodal teaching is its ability to reduce cognitive overload. Understanding these connections, in combination with the principles and formats of modalities used, is essential when designing a cognitive multimodal study.

Literature Review

An extensive review of the literature and current textbooks on lactation, obstetrics and maternal child nursing revealed wide opinions and variations of information and deficiencies in the area of lactation and breast health (Appendix A). More specifically, the incidence, pathophysiology and risk factors of lactation mastitis vary in consistency, depending on the study and source reviewed.

An additional area of importance reviewed for this study was an analysis of skill acquisition and cognitive learning using both unimodal and multimodal teaching strategies.

The published statistical percentage of the incidence of lactation mastitis widely varies in range from textbooks to journal articles. Over the past 30 years, there is outdated information available with a few evidence based current reports available that vary throughout the span of time reviewed. A university nursing textbook quotes a 2% to 10% incidence of mastitis among breastfeeding mothers, (Ladewig, P.A., London, M.L., & Davidson, M.R., 2006), whereas a journal article states 4%-33%, depending on the methodology used in gathering the statistical data (Fetherston, 1998). Separate citations further categorize the incidence of mastitis during the first three months and beyond the sixth month postpartum period. One author cites the incidence at 75-95 % of cases occurring before 3 months of age based on the World Health Organization (Spencer, J., 2008). The majority of citations agree that most mastitis cases are diagnosed during the initial first 3 months of breastfeeding (Riordan, J., Nichols, F., 1990; Fetherston, 1998), with 18% of women stating that mastitis was the reason for cessation of breastfeeding. In a study of 1000 women who breastfed, 9.5% of the breastfeeding mothers also experienced mastitis within the first three months (Lawrence, R., 2002). It is also important to consider the unreported cases as noted in a sample of 91 women studied who had mastitis; one-third did not report it to their physician (Riordan, J., Nichols, F., 1990). A current study on the treatment of staphylococcal mastitis describes mastitis as a “common disease” during lactation varying at 3% to 33% of lactating mothers (Fernandez, L., 2008). This study also found that a high number of women eventually became infected. As noted, there are several factors that influence the published incidence of mastitis. A fluctuation of 2% to 33% incidence is due to underreported cases, quantity of study participants, geography of study, outdated textbooks and few current research studies being available.

Risk factors reviewed for mastitis have been documented at length and are fairly synchronous in nursing textbooks and journal articles. The strongest risk factor for recurrence is noted as having had a previous history of mastitis (Lawrence, R., 2002). Another study of 304 women found that plugged ducts and increased levels of maternal stress brought on by external factors were significant predictors of mastitis in mothers who had previously breastfed. A blocked duct, overly tight brassiere, latching difficulties and nipple pain and fissures were also noteworthy risk factors for new mothers (Featherstone, 1998). Improper breastfeeding techniques due to poor positioning, inadequate removal of milk during consecutive breastfeeding episodes, and poor performance of manual pumps were also factors found when studying risk factors (Foxman, B., Schwartz, K., Looman, S. 1994). Early identification of risk factors and proper treatment as instructed by a provider can prevent the advancement of plugged ducts with local massage, moist heat and frequent rest or nap periods throughout the day (Lawrence, R., 2005).

A review of several textbooks and teaching materials on breast and lactation found the anatomy and physiology of the breast limited in accuracy and effective illustrations. In several texts, (see Appendix A), dated black and white sketches were used as illustrations of the breast at various stages of development or during lactation. These single pictures limit the learner in synthesizing the breast anatomy in relation to the pathophysiology of mastitis during lactation. The physiology of lactation is complex, involving integration of neuronal and endocrine mechanisms in five separate and essential phases (Blackburn, S., 2007). It is essential to have clear knowledge of these phases of mammary development, lactogenesis and involution to recognize and provide effective treatment when breast complications arise, such as mastitis. Williams Obstetrics (1997) describes mastitis as a rare complication, devoting only one and one-half pages to lactation. In contrast, information on the topic can be as extensive as a full chapter as seen in Riordan's Breastfeeding & Human

Lactation (2005). Other textbooks for health professionals cite the anatomy of the breast to have 15-20 milk producing ducts (Bannister et al., 1995) or up to as many as 27 milk producing ducts (Going J., & Moffat, D., 2004). Some sources teach that these ducts empty into lactiferous sinuses near the nipple to store milk until needed by the infant. The concept of lactiferous sinuses and the standard model of the human breast was originated in 1840 when Sir Astley Paston Cooper, M.D., injected a wax process into a cadaver, artificially overinflating the ducts to have storage areas called lactiferous sinuses (Cooper, A.P., 1840). New evidence, using ultrasound imaging, identified an average of only nine tubular milk ducts that branched from the nipple to the peripheral breast, capable of dilating to hold more milk after milk ejection and before baby suckles (Ramsay, D., Kent, J., Hartmann, R., & Hartmann, P., 2005). This more recent study also did not identify “lactiferous sinuses” as previously noted in multiple print materials. If the milk is not released, the duct diameter decreases back to a resting state causing a backward flow of milk. This may cause milk stasis and lead to a plugged duct, a risk factor for mastitis (Riordan, J., & Nichols, F., 1990). Ramsay’s study suggests that duct function is for transport of milk, not the storage of milk and that ducts are “readily occluded by light pressure” (pp.532). This recent evidence using ultrasound technology of the lactating breast offers new information on the anatomy and physiology of milk synthesis and milk expression in the lactating breast (Ramsay, D., Kent, J., Hartmann, R., & Hartmann, P., 2005). This research highlights variations of breast anatomy taught in the literature which limits healthcare workers comprehension for effective management of clients. The recent ultrasound data reveals that lactiferous sinuses do not exist and ducts do not expand to the degree that was previously thought, and taught. The “back flow” of milk, if not removed, is a precursor to breast engorgement, mastitis and more seriously, breast abscesses. It is essential for healthcare

providers to learn and utilize this updated evidence-based knowledge in order to teach and increase the mother's chances of successful breastfeeding.

In addition to the new knowledge of the lactating breast, there are also new methods of learning this information that have been tested for efficacy. A literature review on the effectiveness of using multimodal tools for teaching was undertaken as structurally essential to this study. An equally important understanding and review of new research on dual coding and cognitive overload was also undertaken. Mayer has extensively researched the attributes that effect multimedia learning and documented the results of multiple studies on multimodal learning tools. His work defines cognitive overload as when the "learner's intended cognitive processing exceeds the learners intended cognitive capacity" (Mayer, R., & Moreno, R., 2003., pp. 43). New research on cognitive science has discovered that repetitive traditional methods of verbal teaching often limit students from retaining valuable skills or absorbing a working knowledge of the lesson beyond the end of the classroom session (Udovic, Morris, Dickman, Postlethwait and Wetherwax, 2002). The merging of human information processing is often bottlenecked in the processing stages exhibiting capacity limitations of cognition (Marois, R., & Ivanoff, J., 2005). With this in mind, the concept of dual coding has been researched and theorized to support the use of multimodal designs to stimulate two separate pathways in processing information. The dual coding theory states that the "learner possesses a visual information processing system and a verbal information processing system, such that auditory narration goes into the verbal system whereas animation goes into the visual system" (Mayer, R., & Moreno, R., 1998., pp.2). In this manner, cognition of the information is increased as the dual channels hold two different representations of the information and "build connections between them". A review of eight studies on the effectiveness of multimedia learning concluded that students generated a median of over 75% better scores for

problem solving when integrated verbal and visual formats were used in the explanation (Mayer, R. 1997). In multimedia learning, the cognitive processes of selecting, organizing and integrating visual and verbal information yields text and imagery models to build connection between the parts of information (Mayer, R., 1997). This creates a simple cause-and-effect explanation of the information using an auditory narration with visual animation to promote meaningful learning.

Clinical competence and proficiency as a professional nurse is expected soon after graduation. Knowledge retained from university lectures and experience from clinical hours is soon put to the test as nurses begin new careers. The acquisition and development of a skill is a journey that is best defined in Stuart Dreyfus Model of Skill Acquisition (Benner, P. 1984). In this, the student is stated to pass through five levels of proficiency from “novice to expert”. Patricia Benner further adapted these levels of skill acquisition to define similar stages in the development of clinical competence in nursing (Appendix C). This has been an effective tool to use when measuring and evaluating the nurses’ comprehension and performance as effective caregivers.

Research Questions

The intent of this study is to collect data on the knowledge acquired and retained about mastitis before and after viewing a 22 minute multimodal video on third semester baccalaureate nursing students. The results of this study may further the understanding of modalities to use in the future when educating healthcare workers on topics used in practice. This study provides current evidence based information on the anatomy and physiology of the lactating breast as well as prevention, diagnosing and treating lactation mastitis. The authors sought answers to the following questions:

- 1) Is there a difference between knowledge learned and retained about postpartum lactation mastitis in third semester baccalaureate nursing students enrolled in a required childbearing

course comparing traditional teaching and learning modalities with a multimodal graphic animated learning video?

- 2) Is there a significant difference in third semester nursing students' knowledge acquisition using a 22 - minute multimodal teaching video on lactation mastitis?
- 3) After viewing the multimodal video, is there a difference in third semester nursing students' reported confidence in educating and caring for postpartum mothers about mastitis?
- 4) After viewing the multimodal video, is there a significant difference in third semester nursing students' reported comfort level in explaining mastitis prevention and treatment to postpartum mothers and professionals?
- 5) After viewing the multimodal video, is there a significant difference in third semester nursing students' ability to articulate a description and treatment of mastitis to a new mother and in medical terminology?

Definition of Terms

In this study, the independent variables identified are single traditional teaching methods, multimodal teaching video and postpartum lactation mastitis. The conceptual definition of a *traditional teaching method* is a passive, teacher-directed learning style utilizing single unifocal tools in lecture such as text-books, worksheets and overheads (Udovic, Morris, Dickman, Postlethwait and Wetherwax, 2002). In this study, third semester nursing students initially receive information on lactation mastitis in a reading assignment from a textbook. *Multimodal* teaching is defined as using more than one modality in the presentation of information (Mayer, R. 1997). In this study, third semester nursing students view a multimodal video program on lactation mastitis that integrates visual, verbal and auditory modes through narration, text, and graphic animation. *Lactation mastitis* is defined as localized, painful inflammation of the breast occurring with flu-like

symptoms and a fever of 38.5 C or more that develops during the postpartum period of lactation (Riordan, J., 2005; & Spencer, J., 2008). In this study, the potential of lactation mastitis can be experienced anytime during the breastfeeding phase.

The dependent variables examined in this study are *acquired and retained knowledge*. Acquired knowledge is the practical understanding of a subject from resources which are external or a possession of information, facts, ideas, truths or principles. Mayer and Moreno (2003) further describes the definition of retention as *meaningful learning* in which a deep understanding of the material is “mentally organized into cognitive structure, integrated with relevant existing knowledge and reflected in the ability to apply what was taught to new situations” (pp.43). In this study, the acquired knowledge is gained from the various teaching modes utilized when teaching students about mastitis. Retained knowledge is the preservation of the viability of information that remains in the system once introduced (Newman, B., & Conrad, K., 1999). In this study, retained knowledge of mastitis was analyzed after the nursing students were exposed to various modalities in teaching mastitis and found to support the theory on multimodal teaching as superior to traditional unimodal teaching.

Significance to Nursing

The results of using a multimodal teaching tool in a video presentation format may be beneficial to future nurse educators in nursing and health science courses as well as health care environments. Cognitive researchers now know that thinking occurs in the working memory phase through the dual coded elements of verbal/text and visual/spatial without interference (Fadel, C., 2008). The video designed in this study utilizes these multiple modes of processing information that will further augment the understanding of acquired knowledge. This focused research that supports the principles of multimedia design will influence the eventual transition of traditional learning modes

in healthcare towards implementation of successful multimedia instruction. If the information presented on mastitis is successfully retained in nursing students, this study will further support multimodal teaching strategies to maximize cognitive learning in the classroom. Learning may then be designed to minimize cognitive overload, augmenting understanding of the pathophysiology of mastitis that will better prepare nurses to teach, recognize and treat signs of mastitis in postpartum women. Ultimate results in nursing from this study may be shown in future reductions of the incidence of lactating mastitis.

Chapter 2 – Method of Study

Introduction

Pre- and post- testing of knowledge acquisition and retention of third semester baccalaureate nursing students about the pathophysiology of mastitis, complications and nursing/medical management was analyzed. Two separate teaching methods were used to present the information to nursing students. Data obtained from pre and post tests also included reported student comfort and confidence in the counseling and care of women with mastitis.

Type of Design

This study used a quantitative Pretest-Post-Test Experimental Design, also known as a Repeated Measure RM-ANOVA. Paired t-tests were used in the analysis to compare paired sets of scored tests against the multimodal post-video tests for the efficacy of retained knowledge. In designing this study, much effort was taken by the investigators to create a 22 minute multimodal/multimedia video compact disc (CD) with the most current evidence-based information on lactation mastitis. The video production was a lengthy process that included expertise from a graphic design artist and an audio/visual (A/V) producer. Interviews with women who have experienced mastitis firsthand give insight from a patient's perspective to the viewer. Two licensed lactation specialists were consulted for accuracy in current medical treatment, patient education and diagnosis used in the postpartum course of mastitis today. The content of this study on the anatomical and pathophysiological processes of the breast during mastitis are based on the most current evidence-based knowledge available today.

In this study, there were three measures of the dependent variable, knowledge acquired and retained for each subject (Polit, D., & Beck, C., 2008). It had two independent variables known as the unimodal traditional teaching method and secondly, the multimodal video on mastitis. There

were three data collection points to measure the dependent variables of knowledge acquired and retained about lactation mastitis. An evaluation tool designed in the form of a 16 question test also had an additional short questionnaire to measure the student's confidence and comfort levels regarding the subject of mastitis (see Appendix D). The two pre-video tests and the one post-video test were identical for obtaining comparative data that was useful to analyze. The following is the design for this study.

Pretest 1 – Pretest 1 was given in the classroom to 129 third semester baccalaureate nursing students who had a single 1 hour lecture as well as some textbook required reading on infant feeding & nutrition that also included breastfeeding and lactation. This did not include any postpartum care or complications such as mastitis. Paper and pencil tests were provided with 60 minutes for completion.

Pretest 2 - This test was identical to Pretest #1 but presented to students through the university secure web-based testing tool known as “Blackboard”. By this time, the same 129 baccalaureate students had completed their entire obstetrical and gynecological nursing lectures and reading requirements that included antenatal, intrapartum and postpartum care and complications experienced in the breastfeeding mother. Traditional teaching methods utilized included classroom lectures with some PowerPoint handouts and required reading from academic course selected childbearing and neonatal textbooks. Students also completed 90 hrs on an obstetrical and gynecological nursing unit caring for pre and postpartum woman with and without complications. Some students may have had an opportunity to spend 4-6 hours with a lactation specialist as part of their clinical rotation.

Post-video test 1- This third test was also identical to both pre-tests and was available to students to take on “Blackboard”. In addition to the previous preparation in lecture and

clinical hours, students were asked to view the 22 minute multimodal video designed for this study called, “Living through Mastitis”, prior to taking this third test. Results of the tests were immediately available to the investigator of this study.

Setting for Study

The educational material presented for the students was available to students in three ways. The *lectures* for the obstetrical and gynecological sections were in the university classroom which has access to PowerPoint’s, overheads and lecture podiums. The multimodal video was presented through a secure educational website known as “Blackboard”. The students viewed the video on Blackboard, took pretest 2 and Post-video Test1 at the university or in the privacy of their secure logon from a venue of their choice such as their home or library. One investigator for this study had access to setting up the tests on Blackboard, tracking submitted tests and troubleshooting any web issues the students may have encountered during the process.

Population and Sample

There were 129 4th year (third semester) baccalaureate nursing students enrolled at a major university based out of four sites in Eastern Washington. A total of 112 students (86%) chose to participate in this study; however, only 90 students (80%) completed the three testing points. The other 20%, or 22 students, completed only 1-2 of the 3 tests. Eighteen (16%) of the students were male and ninety-four (84%) were female. Both male and female students possess varied personal and professional experiences in childbirth and infant nutrition.

Students had a 90 hour OB/Neonatal clinical experience with a ratio of 10 students to 1 experienced clinical instructor. All students were enrolled in a 3 credit theory course with a single instructor presenting the material in person, or through the state-wide real-time

interactive computer-based techniques. The nursing students' participation in this study was explained as completely voluntary, without negative impact on grades earned for the course. An incentive for one extra credit point was offered by their instructor for any student who chose to participate in this study for all three stages of testing.

Instrumentation: Reliability and Validity

The instruments used for all three testing points were identical and assessed for stability, consistency and accuracy. A thorough review of the literature was the source of questions that reflected current medical knowledge of the anatomy, pathophysiology and treatment of lactation mastitis as well as to construct a competent multimodal tool to test. A total of sixteen exam questions were constructed for ease of comprehension using a multiple choice format and case study approach. Examples and study materials from current professional nursing exams, such as the NCLEX, were viewed for question design and arrangement of the information. An additional self rating scale was also included on the test concerning students' individual comfort and confidence in counseling and caring for women with mastitis. The Cronbach's Alpha score of 0.95 for the eight standardized items of student confidence and comfort showed high internal overall reliability during the entire testing periods. A final section of the instrument was in essay format to evaluate student comprehension and proficiency of lactation mastitis pathophysiology, treatment and referral needs. The reliability of the two essay questions, based on Cronbach's Alpha score of 0.85, was also strong.

The instrument was tested for interrater reliability and validity using a consensus approach on ten Master prepared nursing students. Using a 5-point scale of relevance, the questions were assessed for straightforwardness and difficulty. Points were rated as 1= meaning "not at all", to 5= meaning "very much so". The focus was also on evaluating individual test items as relevant and appropriate for knowledge required to identify, counsel and treat mastitis. Based on the graduate student's comments,

certain questions were then revised for consistency of the knowledge being tested as well as format of the questions. The content validity index (CVI) for each question is seen in Table 1. Overall Straightforward CVI – mean of the test questions were 4.49. Overall test difficulty CVI- mean was 3.22. Table 2 also reflects the number of correct and incorrect questions by the masters prepared reviewers when they completed the exam themselves. This reflects their current knowledge base about the subject matter.

Table 1 – Instrument Reliability

Question #	#correct	#incorrect	#NA	Straightforward Level CVI Mean	Difficulty Level CVI Mean
Q1	3	3	4	4.7	2.4
Q2	5	1	4	4.8	2.9
Q3	2	4	4	4.8	3.0
Q4	4	2	4	4.5	2.9
Q5	2	3	5	4.3	2.7
Q6	3	2	5	4.9	3.3
Q7	3	2	5	4.6	3.1
Q8	0	4	6	4.1	3.0
Q9	2	3	5	4.2	3.2
Cs Study 1	4	0	6	4.2	3.2
Cs Study 2	4	0	6	4.3	3.8
Total Mean				4.49	3.22

Video Production

To create the multimodal video, a story board was first created in the fall of 2008 by the researchers and an additional graduate student using the most current evidence-based information and research available (Appendix E). A storyboard is a written series of panels of rough sketches that can be edited and formatted to outline the framework and sequence of content intended for the multimodal video. The storyboard went through numerous revisions with assistance from the researchers, content experts, lactation specialists, a graphic artist and a professional video producer. During this process,

three women with a history of mastitis were video-taped and interviewed by a lactation specialist from an outpatient clinical facility. Relevant personal experiences and information were inserted into the storyboard to emanate an impact of real-life encounters with mastitis. An experienced graphic artist and illustrator devoted hours of research on the subject of anatomy and physiology, microbiology, and breast illustration development to meet the needs of accurate portrayal of original images within the video production.

Data Collection Procedure

All stages of the testing process were exclusively managed by the investigators of this study. Pretest 1 was a paper test taken in the classroom that was proctored by the investigators. The exams were stored in a locked cabinet in the investigators office until analyzed. Pretest 2 and post-video test 1 were posted on the web-based secure university “Blackboard” site at specific times that were determined by the investigators and course instructor after knowledge presentations to the students were complete. One of the investigators had exclusive access to post and collect the test results. Students were given 1 week to take each test at determined times. Pretest 1 was taken during the week of February 12th. Pretest 2 was taken via Blackboard during the week of April 8th. Post video test was taken via “Blackboard” during the week of April 28th. Printed versions of all Blackboard tests were stored in a secure cabinet until analysis of results took place.

Data Analysis

All data were entered into SSPS 17.0 with one to three measurements per variable for pre video quiz 1, pre video quiz 2, and post video quiz 1 responses. Multiple choice responses were coded as either correct or incorrect. Paired t-tests were utilized to compare the three testing points at different intervals to show changes in mean scores for students who completed the tests. There were 6 Likert-type (1- Not at all to 5 - Very) questions that measured student self-reported confidence in

understanding mastitis, assessing mothers for mastitis, and referring mothers who have mastitis. An additional 2 Likert-type questions concerning student's self-reported comfort in explaining mastitis and its prevention to mothers and health professionals was included. Both the confidence and comfort scores were analyzed using the paired t-test for individual total scores as well as mean levels for each wave of testing. Two short answer essay questions assessed students' ability to describe mastitis in nursing/medical terminology and in lay terms. These two short answer questions were scored and evaluated for content using Benner's Stages of Clinical Competence (see Appendix B) and further evaluated by the paired t-test method. The ability for the student to articulate and explain the essay questions ranged from no given answer, novice, advanced beginner, competent, proficient or expert.

Human Subjects Considerations/IRB Education

The Washington State University (WSU) human subject's protocol was followed and all forms completed. Approval for this study was received from the WSU nursing department, and then submitted to the University Institutional Review Board (IRB). National Institute of Health (NIH) training certification is included for investigators of this study.

Chapter 3 FINDINGS

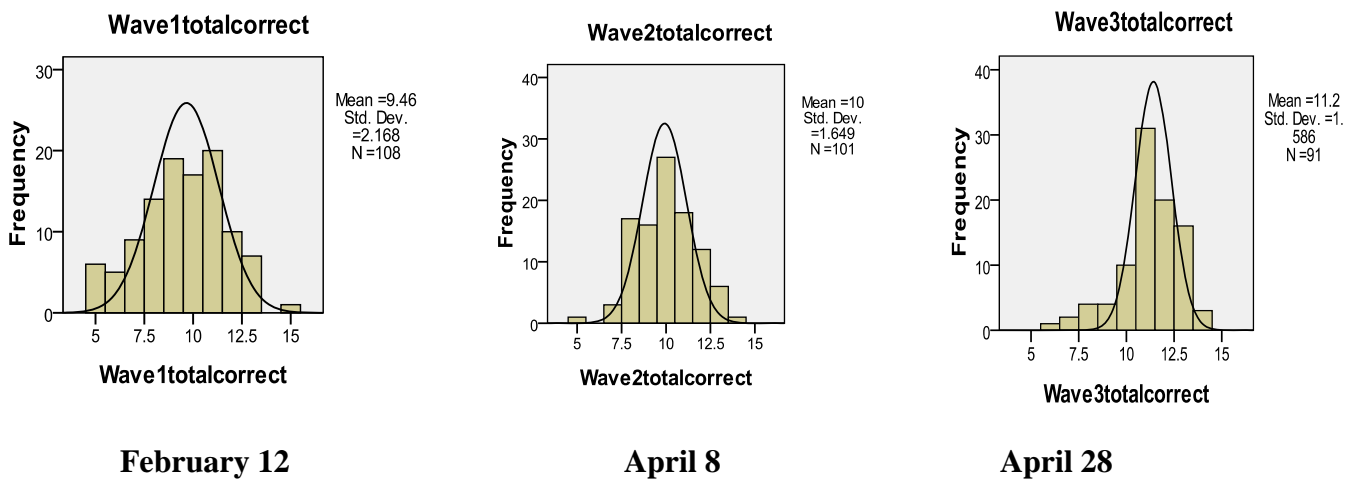
Introduction

Research Question #1

Is there a difference between knowledge learned and retained about postpartum lactation mastitis in third semester baccalaureate nursing students enrolled in a required childbearing course comparing traditional teaching and learning modalities with a multimodal graphic animated learning video?

Using individual histograms with a normality curve and graph reflects the mean score of each of the three waves of testing. The difference seen in the three waves in Graph 3, demonstrate a progressive improvement in the mean number of correct answers at each of the three stages of testing of 9.46, 10.1 and 11.2 respectively. The curve visually illustrates a shift to the right of the third histogram labeled Wave 3. The mean for this type of measurement does not reflect the true amount of knowledge acquisition in the student's responses. More importantly, the range of correct answers was increased by more students at each stage of testing, increasing in the frequency of total students testing. On the Post video test, the range of correct answers was 10-14 in comparison to the pretest range of 7.5-11 correct answers.

Graph 1: Changes in total correct answers over time of study histogram



Research Question #2

Is there a significant difference in third semester nursing students’ knowledge acquisition using a 22 - minute multimodal teaching video on lactation mastitis?

Using paired t-test, this research question found a significant difference in scores between test wave 1 and wave 3, wave 1 and wave 2 and finally, wave 1 and 3. The visual change in total number of correct answers is illustrated in Graph 2 and Table 2.

Graph 2: Total number of correct answers

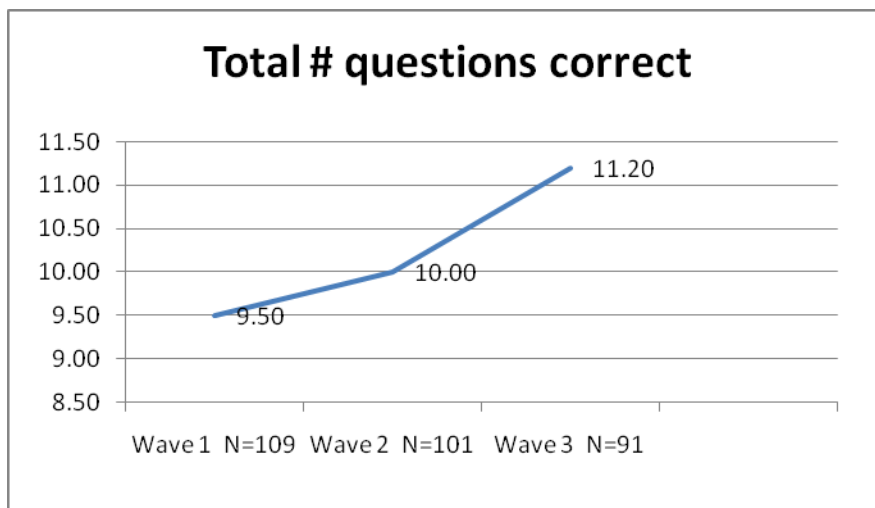


Table 2: Mean Number of correct answers= Wave1, Wave 2, Wave 3 Statistics

	Wave1totalcorrect	Wave2totalcorrect	Wave3totalcorrect
N Valid	108	101	91
Missing	4	11	21
Mean	9.46	10.00	11.20
Median	10.00	10.00	11.00
Std. Deviation	2.168	1.649	1.586
Variance	4.700	2.720	2.516
Sum	1022	1010	1019

An analysis of variance (ANOVA) between the three stages of testing is seen in the following paired t-test table (Table 3). Using the traditional teaching methods, including clinical experience between wave 1 and wave 2, the *p* wave of 0 .098 shows that the students had no significant gain of knowledge. Paired t-tests that compared baseline knowledge of mastitis in wave 1 with the post-video test in wave 3 revealed significant increases of retained knowledge (*p*=.0005, 95% CI -2.15, -1.18). This significant increase is examined to have occurred between wave 2 testing and the third wave of testing. The multimodal video was viewed at this time resulting in a significant difference in knowledge retained, (*p*=.0005, 95% CI= -1.7, -.83).

Table 3: T-test of Paired Samples

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
Paired waves						Lower	Upper		
Pair 1	Wave1totalcorrect Wave2totalcorrect	-.412	2.431	.247	-.902	.078	-1.670	96	<i>P</i> = .098
Pair 2	Wave1totalcorrect Wave3totalcorrect	-1.670	2.314	.243	-2.152	-1.188	-6.884	90	<i>P</i> = .0005
Pair 3	Wave2totalcorrect Wave3totalcorrect	-1.267	2.076	.219	-1.701	-.832	-5.788	89	<i>P</i> = .0005

Research Question #3

After viewing the multimodal video, is there a difference in third semester nursing student’s reported confidence in educating and caring for postpartum mothers about mastitis?

This section of the test was self-scored rating scale used by the students to reflect their level of confidence in dealing with mastitis. The three waves of tests were tools to analyze the student’s confidence level at each stage of learning about mastitis. Baseline levels of the six confidence items

included understanding, cause and effects, treatment, counseling, assessing and referring a new mother. Total self scoring results for all six items could range from 0-30. The mean of wave 1 (pretest) self-reported scores was 11.17, wave 2 mean (prevideo) = 12.54 and wave 3 (post video) was 18.54. A histogram of all three waves displays a significant shift in the frequency distribution of students with varying skewed distributions. Graph 3 and Table 4 shows a high student population with low confidence scores of 6-12 prior to any type of teaching on mastitis (wave 1). The prevideo scores are slightly higher with the majority of students ranging in the 13-18 range. A statistically significant increase in overall confidence levels as well as an increase in the number of students who reported higher confidence scores after the multimodal video (wave 3) with a self-score of 24-25 out of 30, ($p=.0005$) is noted in Graph 3 with a shift to the right in the histogram.

Graph 3: Total Confidence Scores (out of 30)

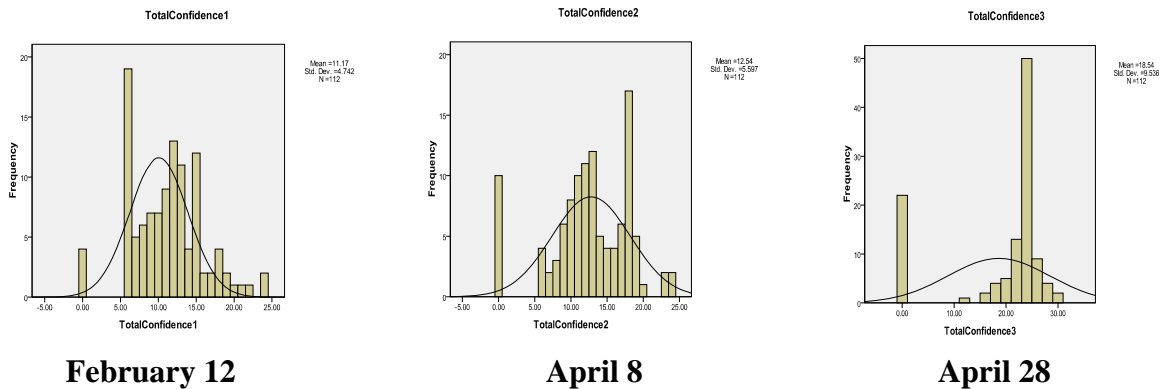


Table 4: Total Confidence Scores (out of 30)

Wave	N	Mean	Std.Dev.
Total Confidence Wave 1-Feb. 12	112	11.17	4.742
Total Confidence Wave 2-April 8	112	12.54	5.597
Total Confidence Wave 3-April 28	112	18.54	9.536

Research Question #4

After viewing the multimodal video, is there a significant difference in third semester nursing student's students' reported comfort level in explaining mastitis prevention and treatment to postpartum mothers and professionals?

The students self-reported comfort levels in explaining mastitis prevention and treatment significantly improved over the three waves of testing. The mean scores out of a 10 after the traditional teaching methods were complete were 3.06 (wave 1) and 3.66 (wave 2). A shift in increased self reported comfort is observed after wave 3 with a mean of 5.82 as seen in Table 6. A statistically significant increase in overall comfort levels as well as an increase in the number of students (40-50) who reported higher comfort scores of 8 after the multimodal video (wave 3) also displays a shift to the right in the histogram. The CI = 95%, $p=.0005$.

Graph 4: Total Comfort Scores (out of 10)

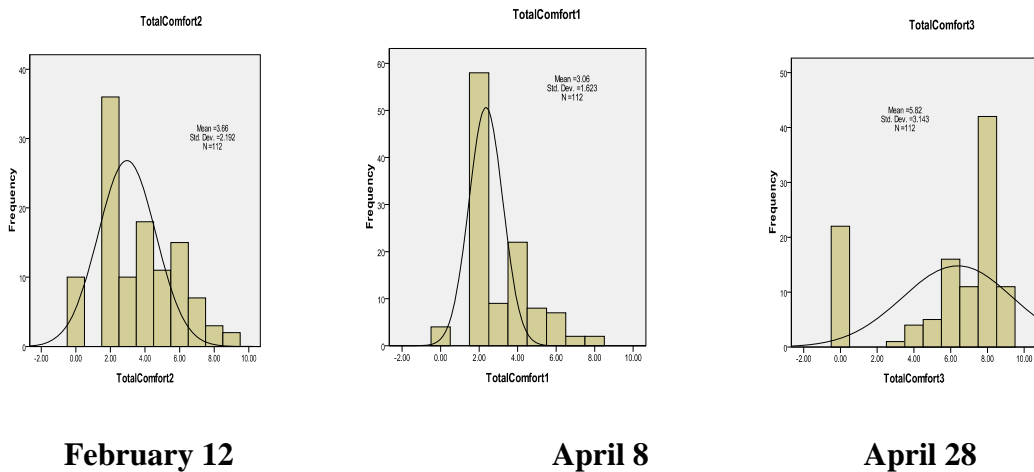


Table 5: Total Comfort Scores (out of 10)

Wave	N	Mean	Std.Dev.
Total Comfort - Wave 1-Feb. 12	112	3.06	1.623
Total Comfort - Wave 2-April 8	112	3.66	2.192
Total Comfort- Wave 3-April 28	112	5.82	3.143

Research Question #5

After viewing the multimodal video, is there a significant difference in third semester nursing students' ability to articulate a description and treatment of mastitis to a new mother and in medical terminology?

The students' responses to the two essay questions were analyzed according to Benner's Stages of Clinical Competence (Appendix B) during the three testing periods of wave 1, wave 2 and wave 3. The investigators of this study rated each essay according to the student's ability to articulate their understanding of mastitis as well as the level of content being described.

The results of the first essay question of wave 1, as seen in Graph 3, shows 56% of students did not answer the question while 37% had a very limited amount of information in the novice category. The frequency shifts dramatically after the multimodal video viewing as seen in wave 3. Only 28% had no answer, while 48% was novice and advanced beginner combined. There were statistical differences between wave one and two, but more students moved into the advanced beginner and above categories in wave 3. In addition, there were 14 students ranked in the highly proficient and 1 student in the expert categories in wave 3.

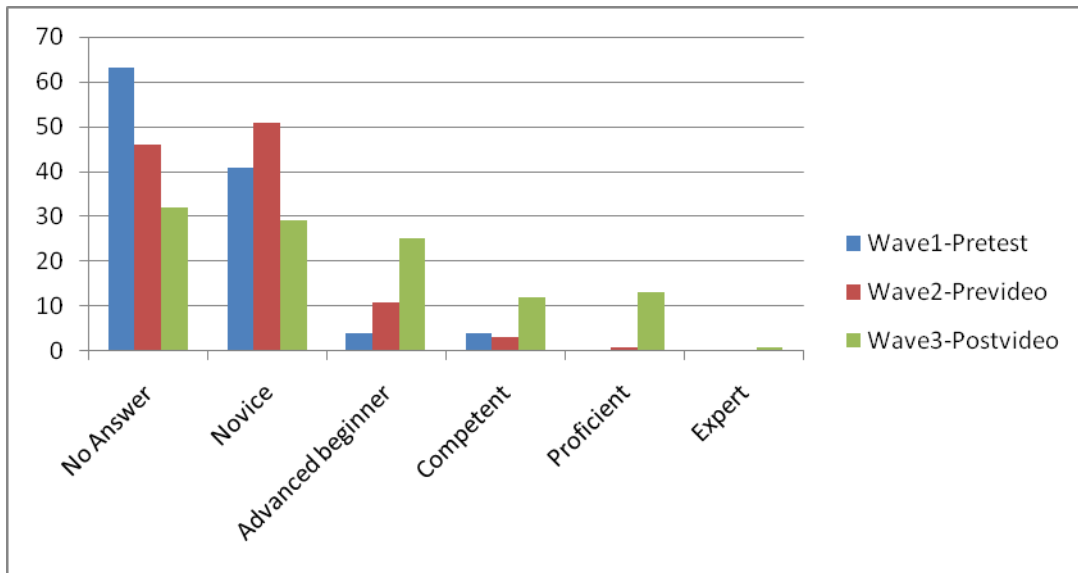
Table 6: Essay Question 1 significance:

Describe mastitis in nursing/medical terminology

	Wave 1- pretest	Wave 2- prevideo	Wave 3- postvideo
Chi-Square	90.929	104.429	38.214
Degree of freedom	3	4	5
Statistical Significance	.0005	.0005	.0005

Graph 5: Categorical Analysis of Essay Question 1

Describe mastitis in nursing/medical terminology.



Question 1: # of Students in Categories

	Wave1- Pretest <i>N</i>	Percent	Wave2- Prevideo <i>N</i>	Percent	Wave3- Postvideo <i>N</i>	Percent
No Answer	63	56.3	46	41.1	32	28.6
Novice	41	36.6	51	45.5	29	25.9
Advanced beginner	4	3.6	11	9.8	25	22.3
Competent	4	3.6	3	2.7	12	10.7
Proficient	0	0	1	.9	13	11.6
Expert	0	0	0	0	1	.9

Analysis of competence in Essay question 2 is similar to question one, but a more dramatic shift between wave 2 and wave 3 is noted. In wave 1 and 2, the majority of students are grouped into the no answer to novice groups; however, in wave 3, over 55% of students ranked in the advanced beginner, competent and proficient categories, with 4 students giving expert descriptions after viewing the multimodal video.

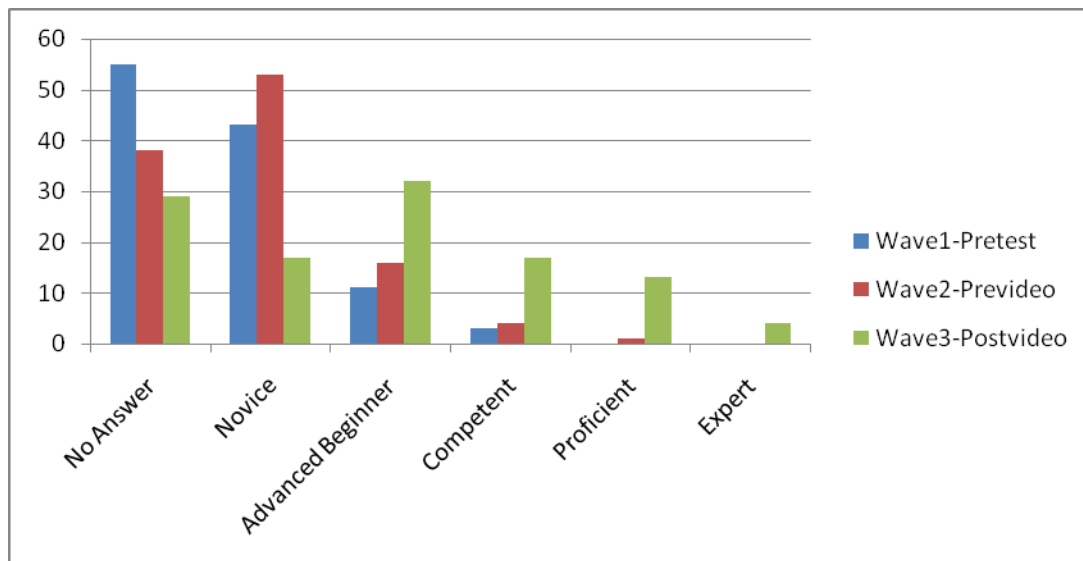
Table 7: Essay Question 2 significance:

Describe mastitis, treatment, and referral process to a new mother.

	Wave 1- pretest	Wave 2- prevideo	Wave 3- postvideo
Chi-Square	66.714	90.054	28.786
Degree of freedom	3	4	5
Statistical Significance	.0005	.0005	.0005

Graph 6: Categorical Analysis of Essay Question 2:

Describe mastitis, treatment, and referral process to a new mother.



Essay Question 2: # of Students in Categories

	Wave1- Pretest <i>N</i>	Percent	Wave2- Prevideo <i>N</i>	Percent	Wave3- Postvideo <i>N</i>	Percent
No Answer	55	49.1	38	33.9	29	25.9
Novice	43	38.4	53	47.3	17	15.2
Advanced Beginner	11	9.8	16	14.3	32	28.6
Competent	3	2.7	4	3.6	17	15.2
Proficient	0	0	1	.9	13	11.6
Expert	0	0	0	0	4	3.6

Chapter 4: SUMMARY, CONCLUSIONS, RECOMMENDATIONS

The foundation for this study was originated by a lactation specialist due to a high incidence of lactation mastitis seen among post partum women in her practice. An observation was noted in the variance of reported cases of mastitis seen in journals and with the actual higher incidence of patients seen in the clinic, many requiring treatment. This propelled a question about the awareness and knowledge of mastitis among medical personnel, specifically nurses who prepare women about postpartum complications. Are nurses adequately prepared in the knowledge needed to be proficient in educating new mothers on the prevention and treatment of mastitis? Can the severity and incidence of mastitis be decreased if lactating mothers are equipped with information needed to prevent, recognize, and treat mastitis? While this research study does not answer these questions, understanding the tools that help nurses learn and retain knowledge, can ultimately impact patients for whom they provide care.

Current research suggests that using multimodal presentations surpasses traditional teaching methods for cognitive learning (Udovic, D., et.al. 2002). The use of multimodal teaching tools in the classroom setting is a current development in improving cognition of acquired knowledge. The conceptual framework for this study is supported by previous research done by past learning theorists that paved the way for understanding cognition. The concept of dual coding and comprehension is demonstrated in this study of using a multimodal teaching tool. Results indicate that nurses were better prepared to teach about the pathophysiology, prevention and treatment of mastitis.

Limitations

The mastitis quiz was constructed as an evaluation tool to measure acquired and retained knowledge of nursing students after viewing the “Living with Mastitis: A Practitioner’s Guide” multimodal video. The quiz was tested for reliability and validity that resulted in the revision of

some questions' format or content. During the testing periods, a few questions were noted to have minimal change in improved scores during the 3 waves of testing. This may be due to problematic format for understanding the intent of the question or possibly a limited coverage of the subject in the video. In either case, the overall results were supportive in the use of multimedia tools to augment learning. Other limitations, based on research findings on multimedia learning, are “efficacy, motivation, and volition of learners, as well as the type of learning task and the level of instructional scaffolding, can weigh heavily on the learning outcomes from the use of multimedia” (Fadel, C., 2008, pp.14).

Implications

The information presented in this study was successfully retained in fourth semester baccalaureate nursing students following the multimodal video production on mastitis. This new information on cognitive retention further supports multimodal teaching strategies to maximize cognitive learning in the classroom. Future learning strategies for health care workers can be designed to minimize cognitive overload, as seen in traditional learning modes, augmenting a better understanding of topics using multimodal tools. The video created for this study focused on enhancing the cognition of mastitis which, in turn, prepared student nurses to teach, recognize and treat signs of mastitis. Ultimate results in healthcare from this study would be shown in the future reductions of the incidence of lactating mastitis among postpartum women.

Recommendations for Further Research

Future research on the incidence of mastitis following universal multimodal teaching strategies in community healthcare environments would be useful to determine the effects of multimedia learning among postpartum healthcare providers. In addition, this video can also be tested on practicing Mother-Baby staff nurses in clinical setting in a pre and post test method.

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Appendix A

Review of Maternal, Obstetric, Breastfeeding and Lactation Textbooks

Textbook	Year	Anatomy & Physiology of breast	Lactiferous sinuses/duct	Graphics	Lacto-genesis	References Sources
1) Williams Obstetrics Authors: Pritchard & MacDonald Publisher: Appleton-Century-Crofts: N.Y.	1980	Ch 9 Ch 19 Ch 36 : other disorders of puerperium: Mastitis-disorder as a rare complication. Only 1.5 pages devoted to lactation.	Yes	Black & white sketches Infrared photos of nonlactating breasts compared to breasts @ 36 weeks antepartum Sketches of developmental process of mammary glands	No	1932-1979
2) Williams Obstetrics (20 th Ed) Authors: MacDonald, Gant, Leveno, Gilstrap Pub: Appleton and Lang-1 ½ pages	1997	Primary breast buds-grow and divide to 15-25 secondary buds Breast engorgement described as pathological w/ only B & W picture. Staphylococcus aureus only offending organism w/ MRSA discussed	No	B &W sketch: birth, pre-puberty, puberty, & pregnancy	Yes-one word only. NO definition	1968-1988
3) Breastfeeding Handbook: A practical reference for physicians, nurses, and other health professionals Authors: Goldfarb, J. Publisher: Enslow Publishers	1980	Lactating breasts resembles a bunch of grapes.	Yes	Sketches	No	
4) Breastfeeding: A manual for health professionals Author: LaCerva, V Publisher:Medical Examination Pub.	1981	15-20 milk producing ducts	Yes + dilates	Black/white sketches	No	1970-1980
5) Nutrition in Pregnancy and Lactation Authors: Worthington-Roberts, Publisher:McGraw-Hill	1997		Yes-Lactiferous ducts and sinuses store milk	Black & White sketches	Yes	1941-1995
6) Breastfeeding: A guide for the medical professional Authors: Lawrence & Lawrence Publisher:Mosby	2005 Update every 4-5 yrs since 1980	Pictures of wallaby & mice breast development ORSA	Yes	B & W B & W sketch of abscess of outer skin	Yes	1957-2003

7) Maternal-newborn Nursing & Women's Health Care (7 th Ed) Authors: Olds, S & London, M., Ladewig Publisher: Prentice Hall Health	2004	Anatomy:1 picture with inadequate depictions; 6 paragraphs Physiology: 4 paragraphs	Yes		No	
8) Breastfeeding & Human Lactation Authors: Riordan, J Publisher: Jones & Bartlett Pub.	2005		Yes	Sketched figures Ultrasound with 1980 photo of milk-filled ducts	Yes: detailed	1953-2002
9) Contemporary Maternal-Newborn Nursing Care (6 th Ed) Authors: Ladewig & London & Davidson Publisher: Pearson:NY	2006	5 small paragraphs on 1 page	Lactiferous duct is displayed as small tubule. Sinus changed to "ampulla"	Colored pictures of woman breastfeeding infant Mastitis: graphic is sketched figure of woman with "red" spot on breast. "Red" spot is dark gray color on black and white. Mastitis: detailed table of factors associated with list of offending organisms.	No	1992-2003
10) Contemporary Maternal-Newborn Nursing Care (7 th Ed) Authors: Ladewig & London & Davidson Publisher: Pearson:NY	2010	3 pages complete with table on comparisons between engorgement, plugged ducts and mastitis. Table on Factors associated with mastitis		Still figure of woman's upper body with "pink" area highlighted on breast with mastitis		
11) Maternal, Fetal, & Neonatal Physiology: A clinical perspective (3rd Ed) Authors: Blackburn, S.T. Publisher: Saunders	2007	**B & W sketch from Ramsay et al (2005) w/ ultrasound imaging This text discusses 4-18 milk ducts which converge at nipple. Mastitis-1 paragraph; no pictures	No	Black and white	Yes	1993-2005

Appendix B

Benner's Stages of Clinical Competence (1984; 2004)

Novice	Beginners have had no experience of the situations in which they are expected to perform. Novices are taught rules to help them perform. The rules are context-free and independent of specific cases; hence the rules tend to be applied universally. The rule-governed behavior typical of the novice is extremely limited and inflexible. As such, novices have no "life experience" in the application of rules. "Just tell me what I need to do and I'll do it."
Advanced Beginner	Advanced beginners are those who can demonstrate marginally acceptable performance, those who have coped with enough real situations to note, or to have pointed out to them by a mentor, the recurring meaningful situational components. These components require prior experience in actual situations for recognition. Principles to guide actions begin to be formulated. The principles are based on experience.
Competent	Competence, develops when the nurse begins to see his or her actions in terms of long-range goals or plans of which he or she is consciously aware. For the competent nurse, a plan establishes a perspective, and the plan is based on considerable conscious, abstract, analytic contemplation of the problem. The competent nurse lacks the speed and flexibility of the proficient nurse but does have a feeling of mastery and the ability to cope with and manage the many contingencies of clinical nursing. The competent person does not yet have enough experience to recognize a situation in terms of an overall picture or in terms of which aspects are most salient, most important.
Proficient	The proficient performer perceives situations as wholes rather than in terms of chopped up parts or aspects, and performance is guided by maxims. Proficient nurses understand a situation as a whole because they perceive its meaning in terms of long-term goals. The proficient nurse learns from experience what typical events to expect in a given situation and how plans need to be modified in response to these events. The proficient nurse can now recognize when the expected normal picture does not materialize. This holistic understanding improves the proficient nurse's decision making; it becomes less labored because the nurse now has a perspective on which of the many existing attributes and aspects in the present situation are the important ones.
Expert	The expert performer no longer relies on an analytic principle (rule, guideline, maxim) to connect her or his understanding of the situation to an appropriate action. The expert nurse now has an intuitive grasp of each situation and zeroes in on the accurate region of the problem without wasteful consideration of a large range of unfruitful, alternative diagnoses and solutions. The expert operates from a deep understanding of the total situation. His/her performance becomes fluid and flexible and highly proficient. Highly skilled analytic ability is necessary for those situations with which the nurse has had no previous experience.

Appendix C

Five major Principles of using Multimedia in the classroom, (Mayer, R., Moreno, R.,)

1. Multiple Representation Principle: It is better to present an explanation in words and pictures than solely in words.
2. Contiguity Principle: When giving a multimedia explanation, present corresponding words and pictures contiguously rather than separately.
3. Split-Attention Principle: When giving a multimedia explanation, present words as auditory narration rather than as visual on-screen text.
4. Individual Differences principle: The foregoing principles are more important for low-knowledge than high knowledge learners, and for high spatial rather than low spatial learners.
5. Coherence Principle: When giving a multimedia explanation, use fewer rather than many extraneous words and pictures.

Appendix D

Mastitis pre and posttest instrument Student ID # _____

Date _____

This Pretest about Mastitis is part of a research study to compare the outcomes of teaching nursing students about mastitis utilizing the standard method of teaching and a multimodal teaching tool designed by WSU faculty, graduate students and staff. You are being offered extra credit for participating in this study and a post test will follow in 4-6 weeks. At the post test time, all data results will be kept confidential with only aggregate data being reported. Consent to participate in the study is implied with you completing the posttest. Dr. Denise Smart, Dr. Margaret Bruya, and graduate student, Maria Castillo are the primary investigators for this study. Any questions can be sent to: dsmart@wsu.edu(509.324.7255)

Directions: Circle the best answer

1. What are the first sign(s) of mastitis?

- a. Redness to breast
- b. Fever
- c. Breast tenderness
- d. All of the above

2. What is the most common pathogen associated with mastitis

- a. Candidiasis
- b. Staphylococcus
- c. Streptococcus
- d. H. Influenzae

3. The drop in what hormone stimulates the production of milk after delivery?

- a. Prolactin
- b. Oxytocin
- c. Progesterone
- d. Estrogen

4. Blocked breast ducts can lead to

- a. Adenitis
- b. Milk stasis
- c. Mastitis
- d. All of the above

5. Phase 2 of breastfeeding is also known as the

- a. Let down phase
- b. Expression phase
- c. Storage phase
- d. Milk production phase

6. Milk is stored in the lactiferous ducts of the breast.

- a. True
- b. False

7. In the first phase of breastfeeding the baby suckles quickly to

- a. Get the most milk as possible
- b. Stimulate the letdown reflex
- c. Satisfy hunger
- d. Comfort self

8. Risk factors leading to mastitis do not include

- a. Cracked and sore nipples
- b. 8-12 feedings per day
- c. Stress and fatigue
- d. Incomplete emptying of breasts

9. The 2 hormones most responsible for milk production are

- a. Thyroid stimulating hormone and estrogen
- b. Oxytocin and progesterone
- c. Prolactin and oxytocin
- d. Prolactin and testosterone

10. Treatment of clinically diagnosed mastitis should involve antibiotics.

- a. True
- b. False

Case study 1: (Question 11-13)

11. MK is a 23 year old new mother about to be discharged after having an uncomplicated vaginal delivery. She is planning to breastfeed exclusively. She asks why she is having increased pelvic cramping with nursing. What do you tell her?

- a. Cramping is a sign of the beginning of a postpartum menstrual cycle.
- b. Stimulation of nipple from suckling of baby stimulates prolactin which causes uterine contractions.
- c. Her cramping is probably due to constipation from pain medications received post partum.
- d. Stimulation of nipple from suckling of baby stimulates oxytocin which causes uterine contractions.

- 12.** Based on the above case study, which of the following teaching tips can you include when educating MK about the prevention of mastitis?
- a. Good nipple hygiene
 - b. Adequate rest, “Sleep when baby sleeps”
 - c. 8-12 feedings per day to prevent milk stasis
 - d. All of the above
- 13.** Two weeks later she reports firmness and tenderness in her left lateral breast. She denies redness, fever and fatigue. All of the following would be important in your instructions to MK, except:
- a. Increase frequency of pumping to ensure effective milk removal.
 - b. Apply cold packs to area before feeding
 - c. Massage the affected area during nursing or pumping
 - d. Apply moist heat to affected area

Case study 2: (Question 14, 15, 16)

JM is a 32 year old mother of four children under the age of 10 and is presently nursing her 3 month old. She doesn't have very much help at home as the father is working two jobs. JM reports her experience of mastitis with each of her children. Over the past month, she has developed sore and cracked nipples. She reports redness and tenderness to the outer upper quadrant of her right breast for 3 days. At this time, JM states she has muscle aches, chills and a temperature of 100.3F orally. Thin red streaks have suddenly appeared on her right breast.

- 14.** Based on the symptoms described by the JM, her diagnosis is:
- a. Infectious Mastitis
 - b. Adentitis
 - c. Granulomatous Lobular Mastitis
 - d. Streptococcal necrotizing fasciitis
- 15.** Which of the following is not a risk factor for JM's diagnosis?
- a. Sore cracked nipples
 - b. Previous diagnosis with breastfeeding
 - c. Obesity
 - d. Fatigue
- 16:** Treatment for JM's condition include all of the following except:
- a. Increasing exercise to increase blood flow to area
 - b. Antipyretic
 - c. Continuation of breastfeeding
 - d. Antibiotic therapy

Directions: Rate on a scale 1 to 5; 1 meaning not at all to 5 meaning very. **Circle one number.**

1. How confident are you in the understanding of mastitis?	1	2	3	4	5
2. How confident are you with the causes and effects of mastitis?	1	2	3	4	5
3. How confident are you in the treatment of mastitis?	1	2	3	4	5
4. How comfortable are you in explaining mastitis prevention and treatment to a mother or lay person?	1	2	3	4	5
5. How comfortable are you in explaining mastitis to another health professional?	1	2	3	4	5
6. What is your confidence level on in counseling a new mother with possible mastitis?	1	2	3	4	5
7. What is your confidence level on assessing a new mother with possible mastitis?	1	2	3	4	5
8. What is your confidence level on referring a new mother with possible mastitis?	1	2	3	4	5

Retention Evaluation (May use additional paper if needed)

Write one paragraph describing mastitis in nursing/medical terminology.

Write one paragraph in lay terms describing mastitis, treatment, and referral process to a new mother.

Answer Key: (not included on test)

1. C 2. B 3. C 4. D 5. B 6. B 7. B
 8. B 9. C 10. A 11. D 12. D 13. B 14. A
 15. C 16. A

Appendix E

Storyboard for “Living with Mastitis” Multimodal Video

<p style="text-align: center;">Living Through Mastitis “A Practitioners Guide”</p> <p style="text-align: center;">Denise Smart and Maria Castillo 3/9/09</p> <p>(Balloon Ride Vol. 3, Tracks 4, 5 and 6) Font – ITC Stone Sans STD, Semi-bold</p>	
<p>1) Martha Lou on camera</p> <p>Maria getting ready to nurse</p> <p>Maria nursing John</p>	<p>1) NARRATOR: When a woman decides to breastfeed her baby, she is making a significant commitment that involves decisions about herself, her baby and her family. For most postpartum women, breastfeeding is an important milestone in their lives. Furthermore, breastfeeding promotes mother-infant bonding, and offers numerous health benefits for both mother and infant.</p>
<p>2)</p> <p>Maria nursing John, baby unlatches</p>	<p>2) NARRATOR: However, complications may arise, which can cause an interruption in the breastfeeding relationship and result in costly and invasive treatments, additional doctor’s visits, and increased physical and emotional stress for mother and infant. A common and often under diagnosed complication is Mastitis.</p>

3) FF Maria and John

Title: Living Through Mastitis

3) background music

<p>4) Martha Lou</p> <p>CG:</p> <ul style="list-style-type: none"> - faster and easier postpartum recovery - decreased risk of osteoporosis - protection against ovarian cancer - reduction in the risk of breast cancers. 	<p>4) NARRATOR: The American Academy of Pediatrics and the World Health Organization have long recognized that breast milk is the ideal form of nutrition for optimal infant and child health. Benefits for mothers include a faster and easier postpartum recovery, a decreased risk of osteoporosis, protection against ovarian cancer, a reduction in the risk of breast cancers, decreased cardiac risk, and Type II diabetes.</p>
<p>5) Continue FF from previous frame, bring in colostrums Graphic</p> <p>CG:</p> <ul style="list-style-type: none"> - protects the gastrointestinal and respiratory tracts from pathogens, - aids in digestion - allows for optimal physical and mental development 	<p>5) NARRATOR: Breast milk contains the exact nutrients needed for the baby, changing as the baby grows. In the first week of nursing, immunities are built naturally by a high-density brain food called colostrum. The unique composition of breast milk is designed for each individual child, helping to protect the gastrointestinal and respiratory tracts from pathogens, aiding in digestion and allowing for optimal physical and mental development.</p>

<p>6) Continue FF from previous frame,</p> <p>CG:</p> <ul style="list-style-type: none"> - mature - secure - with reported higher cognitive development 	<p>6) NARRATOR: From a psychological and social point of view, breastfed babies are more developmentally mature and secure in their environment. There are reported higher cognitive developmental values.</p>
<p>6B) Martha Lou</p>	<p>6B) NARRATOR: The American Academy of Pediatrics and the American College of Obstetricians and Gynecologists recognize that human milk is uniquely superior for infant feeding and is recommended for the first year of life. Nurses and Health Care Providers should be concerned with interruptions in breastfeeding that can disrupt breast milk expression as this can affect breast milk production.</p>

6C) CG:

- engorgement
- plugged ducts
- mastitis
- breast abscess

6C) NARRATOR: Interruptions could be caused by engorgement, plugged ducts, mastitis and more seriously, a breast abscess. In addition, a history of breast surgery, chest surgery, or any injury to the chest wall can cause engorgement or plugged ducts due to scar tissue.

Any of these conditions can be detrimental to the mother and the baby's overall health and well being.

<p>7) Martha Lou</p>	<p>7) NARRATOR: Mastitis affects approximately 2 to 10% of post-partum American women. Even though this equates to as many as 50,000 to 400,000 women annually, it is known to be an under-reported medical condition.</p>
<p>8) CG:</p> <p>- list of objectives</p>	<p>8) NARRATOR: Recent research on the anatomy of the lactating breast supports the need to:</p> <ol style="list-style-type: none"> 1. define mastitis and describe it's characteristics; 2. Classify the two types of mastitis: (adenitis and cellulitis), as well as 3. Identify the signs and symptoms of both. 4. discuss the causes and contributing factors that lead to acute mastitis in lactating women; and 5. Identify causative agents and pathogens associated with infectious mastitis and the method of entry. 6. And finally, discuss evidence-based interventions for mastitis as well as prevention techniques.

<p>9A)</p> <p>Graphic of infectious connective tissue</p>	<p>9A) Narrator: Mastitis is an infection of the breast connective tissue during the second phase of lactogenesis or milk production in lactating women.</p> <p>It is important to differentiate between the various complications that can occur in the new mother:</p>
<p>9B) CG: Engorgement</p> <ul style="list-style-type: none"> - breasts become extremely swollen with generalized warmth - temperature may reach 38.4 C (101.1 F) <p>Graphic of engorged breast</p> <p>Martha Lou</p>	<p>9B) NARRATOR: Engorgement – For some mothers, when her milk is coming in, her breasts become extremely swollen with generalized warmth. The mother’s temperature may reach 38.4 C (101.1 F), but generally, she does not feel ill. <i>In the past, engorgement occurred so frequently, that nurses and physicians considered it to be normal phase of lactogenesis.</i></p> <p><i>But engorgement occurs due to improper or inadequate feeding techniques.</i></p> <p><i>The introduction of formula supplements in the hospital or early days at home due to maternal pain or fatigue can also contribute to engorgement.</i></p>

9C) CG:

Milk Stasis

- Failure to change infant position to allow emptying all lobes of the breast;
- Failure to alternate breasts at feedings; - Poor latch
- Poor letdown

9C) NARRATOR: This is the beginning of milk stasis, which can occur as a result of:

Failure to change infant position to allow the emptying all lobes of the breast;

Failure to alternate breasts at feedings; Poor latch; or

Poor letdown due to maternal nipple pain or improper pumping

Two thirds of mothers do not experience the physical signs of let down

It is critical to address milk stasis because of its relationship to blocked milk ducts, adenitis and mastitis.

<p>10A) CG:</p> <p>adenitis and cellulitis (dissolve cellulitis on cue)</p> <p>Graphic</p> <p>CG: cellulitis</p> <p>Graphic</p> <p>CG: list of symptoms</p>	<p>10A) NARRATOR:</p> <p>Mastitis can be classified into two primary types: adenitis and cellulitis.</p> <p><i>1. Adenitis or plugged milk ducts</i> – The onset for adenitis is gradual, generally after a feeding. It occurs in one breast, and swelling or localized heat may be intermittent. Pain in the breast is localized to one area, and even with an elevated temperature, the mother does not feel ill. Clinical signs and symptoms are less severe. Breast ducts are presumably blocked, resulting in milk stasis. Treatment measures do need to be initiated to prevent progression to cellulitis.</p> <p><i>2.</i> The more severe form of mastitis is also a form of <i>Cellulitis</i> which is where the interlobular connective tissue has been infected. Symptoms may come on suddenly after about 10 days postpartum. One breast may have a pink, tender, hot swollen wedge shaped area. A fever of 38.5C (101.3 degrees Fahrenheit) or greater, with chills and systemic flu-like aches may be one of the last symptoms. If untreated, abscesses or septicemia may occur.</p>
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<p>10B) Martha Lou</p> <p>Graphic:</p>	<p>10B) NARRATOR: Finally, the most severe outcome of mastitis is a breast abscess. A breast abscess is more likely to occur with a history of breast injury, including a previous history of mastitis. This may be related to the inflammatory process which results in remodeling of tissue.</p> <p>If the mother stops draining the breast of milk during an episode of mastitis, either by not pumping the breasts or feeding her infant, she will have increased milk stasis and is at more risk of developing an abscess.</p> <p>A breast abscess presents similarly to mastitis except that there is a firm area in the breast, often with a fluctuance which is an indication of the presence of pus in a bacterial infection. An abscess can be confirmed with ultrasound. Abscesses are treated with surgical drainage or needle aspiration, which may need to be repeated. Fluid from the abscess is cultured and antibiotics administered.</p>
<p>10C) Martha Lou</p>	<p>10C) NARRATOR:</p> <p>While mastitis can occur in non-lactating women, the incidence is less than 1%. First time mothers and breastfeeding mothers with a history of mastitis are at a greater risk.</p>

<p>11) Video of Gail</p> <p>CG:</p> <ul style="list-style-type: none"> - Lack of awareness of personal hygiene (and skin protective techniques), - lack of awareness of the signs and symptoms of mastitis - improper self-medication 	<p>11) NARRATOR:</p> <p>More and more hospitals have realized the benefits of having lactation specialists. Yet, new mothers may still have limited access to a lactation specialist which can lead to a lack of awareness of personal hygiene and skin protective techniques, a lack of awareness of signs and symptoms of mastitis, and often improper self-medication.</p>
<p>12)</p> <p>Graphic</p>	<p>12) NARRATOR: The infection usually begins when bacteria enter the breast tissue as the result of some type of trauma. Sore or cracked nipples may be one type of trauma. Women may self-medicate with over the counter creams, which can further irritate the sensitive skin.</p> <p>As a result of nipple trauma, feedings may be altered, reduced or discontinued.</p>

<p>13) CG:</p> <p><u>Factors that contribute to bacterial access</u></p> <p><u>Breast/Nipple Trauma</u></p> <ul style="list-style-type: none"> - Incorrect positioning for feedings - Poor latch-on - Failure to rotate position on the nipple – - Incorrect or aggressive pumping techniques <p>ACCESS</p> <p>Breast or nipple trauma</p> <ul style="list-style-type: none"> - Poor hand washing techniques - Improper breast hygiene 	<p>13) NARRATOR:</p> <p>Breast and nipple trauma may occur as a result of incorrect positioning for feedings; poor latch-on; failure to rotate position on the nipple; incorrect or aggressive pumping techniques.</p> <p>There are certain factors that contribute to bacterial access:</p> <p>Breast and nipple trauma are first and foremost.</p> <p>Poor hand washing techniques prior to breastfeeding, improper breast hygiene or Improper pump part hygiene are other contributing factors.</p> <p>Bacteria growth can result from nipple trauma and exposure to bacteria</p>
<p>14) CG:</p> <p>Bacterial Growth</p> <p>Plastic lined breast pads</p> <p>Abundant use of occlusive ointments</p>	<p>14) NARRATOR:</p> <p>Things that can amplify bacterial growth are:</p> <p>Plastic lined breast pads</p> <p>Abundant use of occlusive ointments</p>

<p>15) CG:</p> <p><u>Obstruction of Ductal Tissue</u></p> <ul style="list-style-type: none"> - Restrictive clothing - Improperly fitted bras - Maternal sleep position 	<p>15) NARRATOR: Obstruction of ductal tissue may occur when restrictive clothing, or improperly fitted are worn.</p> <p>Anything that presses on the breast can cause obstruction.</p> <p>Even sleeping on the stomach when breasts are filling with milk during the night may create obstruction.</p>
<p>16) CG:</p> <p><u>Change in Feeding Patterns</u></p> <ul style="list-style-type: none"> - Change in feeding patterns - Attempted weaning - Missed feedings - Returning to work - Prolonged infant sleeping - Reduced feedings due to trauma 	<p>16) NARRATOR: Mastitis can result from a failure to empty the breasts, and this can occur due to: a change in feeding patterns, attempted weaning, missed feedings, returning to work, prolonged infant sleeping (including sleeping through the night) and reducing feedings on a breast affected by trauma.</p>

<p>17) CG:</p> <p><u>Maternal Immune defenses affected by:</u> Fatigue and Stress</p> <ul style="list-style-type: none"> - interrupted sleep patterns - returning to work - lack of breastfeeding support - day to day family responsibilities 	<p>17) NARRATOR: Lowered maternal immune defenses are associated with fatigue and stress, due to interrupted sleep patterns, returning to work, lack of breastfeeding support from family or friends, or from just managing day to day family responsibilities.</p>
<p>18) Martha Lou</p> <p>CG: list of risk factors</p>	<p>18) NARRATOR: Any or all of these previously mentioned factors can lead to engorgement , plugged ducts, milk stasis, breast trauma or infection.</p> <p>Additional risk factors for mastitis include: tongue mouth position, ankyloglossia, having an infant with a cleft lip or palate, or a short frenulum, and for the mother: nipple piercings and yeast infections.</p>

21)	21)
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22) Graphic	22) Narrator: Ducts are capable of increasing in diameter temporarily to accommodate the increase in milk volume at milk ejection.
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23) Graphic	23) Narrator: When milk is not removed from the breast within about two minutes, the diameter of the ducts return to a resting state <i>due to the backward flow of milk.</i>
24) Graphic	24) Narrator: Inflammation may occur as macrophages circulate in the blood stream and bind to wounded blood vessels, moving to the site of infection or injury. These macrophages release multiple inflammatory mediators such as cytokines.

<p>25)</p> <p>Graphic of WBC engulfing foreign cells and causing more tissue damage</p> <p>CG:</p> <ul style="list-style-type: none"> - Milk stasis - Breach of skin integrity - Severe inflammation 	<p>25) Narrator: As the inflammation progresses, white blood cells engulf foreign cells. Phagosomes and lysosomes break down microbes, producing free radicals. This further inflames the tissues, resulting in damage.</p> <p>Any one of these three mechanisms: milk stasis, breach of skin integrity or severe inflammation; provides the perfect setting for mastitis.</p>
<p>26)</p> <p>Graphic</p>	<p>26) Narrator: The most common portal of entry of the pathogens causing mastitis is either through a nipple fissure, or by way of the lactiferous ducts to a secreting lobule, to periductal lymphatics or by way of hematogenous spread.</p> <p>So with any one of the mechanisms that have been described, even normal bacterial flora can find the ideal setting for growth.</p>
<p>27)</p> <p>CG:</p> <ul style="list-style-type: none"> - Staphylococcus aureus with more recent evidence of MRSA - Staphylococcus epidermidis - Escherichia coli - A beta-hemolytic Streptococcus - Candida Albicans 	<p>27) Narrator:</p> <p>Some of the more common organisms attributed to mastitis are:</p> <ul style="list-style-type: none"> - Staphylococcus aureus with more recent evidence of MRSA - Staphylococcus epidermidis - Escherichia coli - A beta-hemolytic Streptococcus and - Candida Albicans

<p>28)</p> <ul style="list-style-type: none"> - Staphylococcus aureus and MRSA - Show the organism from the picture <p>Graphic</p>	<p>28) Narrator:</p> <p>Staphylococcus aureus is the most common infectious organism. Staph aureus is frequently found in the nose and skin in about 33% of the population and causes disease through tissue invasion and toxin production. Staph infections are known to cause abscesses which consist of a fibrin wall surrounded by inflamed tissue enclosing a central core of pus containing organisms and leukocytes. From this focus of infection, the organisms may be disseminated hematogenously.</p> <p>Cases of Methicillin-Resistant Staph aureus have been reported have been widely reported, more often presenting as repetitive or resistant mastitis.</p>
<p>29)</p> <ul style="list-style-type: none"> - Staphylococcus epidermidis 	<p>29) Narrator:</p> <p>Staphylococcus epidermidis is similar in cluster shape to staph aureus. It is also an inhabitant of the skin. This organism produces a slime resulting in biofilm formation. It is the ability to form a biofilm that makes this bacteria particularly virulent.</p>

<p>30)</p> <p>- Escherichia coli</p>	<p>30) Narrator:</p> <p>Escherichia coli are a large and diverse group of bacteria. Although most strains are harmless, others can cause severe infection.</p>
<p>31)</p> <p>- Streptococcus</p>	<p>31) Narrator:</p> <p>Group A streptococcus and streptococcus pneumonia species are often found in the throat and on the skin with most people having no symptoms of illness. Infection can occur when these bacteria get into parts of the body where they are not normally found.</p>
<p>32)</p> <p>Candida Albicans</p>	<p>32) Narrator:</p> <p>Candida albicans has been identified in women who report a syndrome of deep pain in the breast during and immediately after lactation. Candida infections may result from antibiotics used in the treatment of bacterial infections for mastitis. Yeast does not grow in breast milk. Candida infections are basically topical but have such a highly inflammatory process that they irritate the 10th intercostal nerve. The resulting pain syndrome greatly impacts milk ejection.</p>

<p>33) Martha Lou</p>	<p>33) Narrator:</p> <p>Treatment of mastitis can begin without milk cultures. An antibiotic that can be tolerated by the infant as well as the mother is generally prescribed. The most common antibiotics for mastitis or breast abscesses are:</p>
<p>34) CG:</p> <p>Amoxicillin/clavulante (Augmentin)</p> <p>Keflex</p> <p>* Ciprofloxacin</p> <p>*Clindamycin</p> <p>Dicolxacillin</p> <p>*Bactrim/Septra</p>	<p>34) Narrator:</p> <p>Amoxicillin/clavulante (Augmentin)</p> <p>Keflex</p> <p>*Ciprofloxacin</p> <p>*Clindamycin</p> <p>Dicolxacillin is generally the first line medication prescribed.</p> <p>*Bactrim/Septra</p>
<p>35) CG - list</p>	<p>35) NARRATOR: Suspected MRSA infections can be treated with Clindamycin, Ciprofloxacin, Bactrim/Septra, as well as Vancomycin or Rifampin.</p>

37) Martha Lou

CG:

- Use meticulous hand washing techniques
- identify early warning signs of breast and feeding problems and
- help the mother with plans for returning to work.

37) Narrator: Prevention of mastitis is always easier than managing treatment. Some women may present with pain and a breast mass as the main symptoms of mastitis rather than fever. Persistently painful breasts and non-healing nipples should be directly examined by a primary health care provider.

A lactation specialist can insure that preventive steps are taken by educating mothers to:

- Use meticulous hand washing techniques
- identify early warning signs of breast and feeding problems
- help the mother with plans for returning to work
- Assist with appropriate latch specific to each mother and infant
- Educate with proper pumping techniques

<p>38) Martha Lou</p> <p>Video of Maria using a breast pump</p>	<p>38) NARRATOR:</p> <p>Too few feedings can result in milk stasis and too many feedings in the early days of nursing can result in nipple trauma.</p> <p>Women who feed 8-12 times per day are less likely to develop mastitis.</p> <p>More feeding in a day may be correlated with improper latch and decreased milk transfer.</p> <p>When anticipating a return to work, the breastfeeding mother should plan well in advance for the separation from her infant.</p>
<p>39) Martha Lou</p>	<p>39) NARRATOR:</p> <p>She may want to obtain a quality breast pump, establish a pumping schedule, and store extra breast milk for the baby. This will also reduce the possibility of engorgement.</p>

40) Martha Lou

40) NARRATOR:

When she returns to work, her pumping intervals should be similar to her feeding routine at home.

During the first few weeks after the mother has returned to work, ideally when she is at home she should be available to nurse her infant.

41) Martha Lou

41) NARRATOR:

She should consult a lactation specialist on the proper use of a breast pump and make sure that she empties her breasts when pumping at work.

The mother may need an assessment to ensure good nursing techniques such as achieving proper latch. She should be encouraged to report any breast trauma or discomfort she may have in her breast.

<p>42) Martha Lou</p>	<p>42) NARRATOR: Unrecognized signs and symptoms can lead to a delay or inadequate treatment, resulting in an acute or recurrent mastitis. When the mother’s health is seriously compromised, it frequently leads to early weaning or total cessation of the breastfeeding experience. A history of mastitis often results in reluctance to breastfeed with subsequent babies.</p>
<p>43) Martha Lou</p>	<p>43) NARRATOR: We can now see that mastitis is a complicated process of infection. Healthcare providers need to recognize the early warning signs of engorgement, adenitis and cellulitis. Mastitis needs to be adequately documented in medical records so that we have a better understanding of its incidence and prevalence. Management and treatment of mastitis needs evidence-based interventions.</p>
<p>44) Martha Lou</p>	<p>44) NARRATOR: By understanding the contributing factors that are associated with breast infections, nurses are in key positions to either prevent its occurrence, or to help mothers live through mastitis.</p>
	<p>Credits and logo</p>