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Development of an Evidence Based Practice Training Program for the Utilization of Nitrous Oxide for Parturient Analgesia at Fort Belvoir Community Hospital

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Disclaimer

Due to the impact of the COVID19 Pandemic, 2020 graduates of the Daniel K. Inouye Graduate School of Nursing were deemed critical to the mission of caring for the health of the nation. All phases of the DNP Project were complete, and met the standards and rigors of a quality DNP Project with an abbreviated dissemination timeframe.

Table of Contents

Abstract

Phase II Site: Fort Belvoir Community Hospital, Fort Belvoir, VA

Project Title: Development of an Evidenced Based Practice Training Program for the Utilization of Nitrous Oxide for Parturient Analgesia at Fort Belvoir Community Hospital

Authors: Papenfuss, E. M., Vance, A. D.

Background or Problem/Issue: Fort Belvoir Community Hospital (FBCH) recently adopted a policy to offer nitrous oxide as an analgesic option to laboring women; however, the staff had minimal to no prior experience using this agent and its unique delivery system. There are potentially serious side effects associated with the use of nitrous oxide. Application of multimodal strategies and Adult Learning Theory has been proven to facilitate increased knowledge retention, skill mastery, and critical thinking.

Clinical Question or Purpose: The purpose of this project was to develop a program grounded by evidence that standardizes training on nitrous oxide for parturient analgesia at FBCH.

Project Design: A two-phased training program was designed: an online activity for knowledge familiarization followed by an in-person workshop featuring a case study, discussion, and hands-on equipment training. Pre- and post-education assessments measured staff knowledge and comfort.

Analysis of the Results: Descriptive statistics were used to evaluate significance. Pre-education assessments illustrated a baseline knowledge deficit and lack of comfort with nitrous oxide for parturient analgesia. Posttest scores (M=90%) for staff who completed the education module were 21% greater than pretests (M=78%). Additionally, a Likert scale revealed a 33% increase in staff's comfort; all participants reported they felt neutral to very comfortable discussing and managing the system.

Organizational Impact/Implications for Practice: This project was successful in applying evidence-based methods and enhancing staff's readiness for a new labor analgesic. Other healthcare sites should analyze current training methods and consider incorporating similar evidence-based education strategies to effectively engage adult learners.

Abbreviated Abstract

Project Purpose: Evidence-based application of Adult Learning Theory principles to a multimodal, in-service training program in order to enhance staff's readiness for a new labor analgesic.

Impact: Applying these methods were successful in enhancing staff's readiness for a new labor analgesic. Other healthcare sites may consider incorporating similar education strategies to effectively engage adult learners.

Introduction

Pain management during labor is an essential component of safeguarding both maternal and fetal health. Labor pain is not only an unpleasant psychological experience, but also a physiologically stressful event; uncontrolled pain and the resulting stress response can contribute to significant consequences such as hemodynamic instability, risk for cardiac arrhythmias, and decreased placental perfusion that leads to fetal hypoxia (Chestnut, Polly, Tsen, & Wong, 2009). Inhaled nitrous oxide and epidural analgesia are two primary means to manage pain for women experiencing childbirth. Most pregnant women (parturients) in Europe and Australia utilize nitrous oxide, whereas epidural analgesia is delivered to 60% of parturients in the United States and only 1% of parturients utilize nitrous oxide (Baysinger, 2018). Nitrous oxide, used for analgesia since 1881 and colloquially referred to as "laughing gas," is inhaled via a simple breathing mask by the patient (Baysinger, 2018; Whitfield, 1992). This non-invasive means of analgesia presents an alternative choice for women who do not desire or cannot undergo epidural analgesia due to risk for complications such as excessive bleeding due to low platelet counts (Chestnut et al., 2009). Fort Belvoir developed a policy to offer nitrous oxide as an analgesic option to laboring women, but lacked a training program to educate staff on the policy change and the safe, effective delivery of the agent to parturients. The hospital desired an education and training program for the obstetrical staff to this inhalational agent and its unique delivery system.

Significance of the Problem

Although considered to have a relatively safe drug profile, serious potential hazards exist for nitrous oxide therapy: altered level of consciousness, expansion of air spaces (ex. pneumothorax, air embolism), delivery of hypoxic gas mixtures, myocardial depression, and respiratory depression (Li, 2017). A single episode of maternal or fetal respiratory insufficiency

on average costs $40,000 in hospital bills, in addition to any secondary chronic complications that may arise such as asthma, cardiovascular problems, and behavioral delays (Fowler et al., 2014). Additionally, middle ear/tympanic membrane damage, anemia, and changes in fertility are also associated with prolonged occupational exposures to nitrous oxide (Li, 2017).

The incidence of these aforementioned risks is poorly defined in the literature, but generally accepted to be rare when nitrous oxide is properly administered and monitored (Li, 2017). However, human-related errors in medicine are often linked to limited experience or unfamiliarity with medications or procedures (Kohn, Corrigan, & Donaldson, 2000). Nitrous oxide is an unfamiliar therapy at FBCH. Approximately 70% of the deliveries performed at FBCH in 2017 utilized epidural analgesia, suggesting the current obstetric practice environment at FBCH relies heavily on epidurals for labor analgesia (FBCH, 2018).

The novelty and potential infrequency of nitrous oxide use at FBCH necessitated staff training to ensure both patient and provider safety. Current literature suggests the effectiveness of training is highly influenced by choice of educational method (Bluestone et al., 2013). This EBP project aimed to develop a comprehensive training platform utilizing evidence based education methods to increase staff knowledge, technical excellence, and comfort with nitrous oxide. Literature suggests that this not only supports staff in maintaining safety and handling clinical events, but also enhances patient education, thereby improving the quality of provider-patient discussions on analgesic options and informed decision-making, which is linked to improved patient satisfaction and health outcomes (Diffenderfer, Dunham-Taylor, Snyder, & Malcom, 2015; Leary, 2015; Marcus, 2014). Educational methods employed in this EBP included in-person and computer training, lecture and case scenario discussion, and hands-on skill practice.

Clinical Question

How does obstetrical staff knowledge on nitrous oxide use for parturient analgesia change after participating in an evidence-based training program?

Focus Areas

This project had four focus areas. First, a literature search was completed to determine the most effective educational methods in maintaining knowledge retention and sustainment over time. Second, obstetrical staff (obstetricians, anesthesia providers, labor and delivery nurses) at FBCH completed a pre-education assessment to determine baseline knowledge of nitrous oxide utilization as a safe analgesic medication for labor pain. Third, training on nitrous oxide was delivered to obstetrical staff as an educational project; a post-educational assessment was utilized to determine the effectiveness of the training. Lastly, we collaborated with the Labor and Delivery Clinical Nurse Educator to implement a sustainment plan for this training.

Relevance

Improving staff education aligns with the Military Health System (MHS) strategic framework and addresses aspects of the quadruple aim: increased readiness, better care, better health, and lower cost. The goal is that obstetrical staff will explain and demonstrate the utilization of nitrous oxide to the parturient as an additional option for pain management. This will increase readiness because the nursing staff will be able to independently deliver nitrous oxide to parturients while maintaining anesthesia provider's ability to respond to other parturients requesting neuraxial analgesia or respond if needed for a cesarean delivery. Better care is attained through increased analgesia options for parturients and the safe delivery of nitrous oxide by trained staff. Patients will have optimal autonomy and decision-making regarding their health care that results in better pain control and higher satisfaction rates reported

by the parturient (Leary, 2015). The training was developed using evidence based modalities, which support a more engaged learner by using pre-course work, in-person case scenarios, and utilization of electronic resources that can be easily accessed (Bluestone et al., 2013; Kennedy et al., 2012). Obstetrical staff are equipped to educate and advocate on alternative pain relief measures to promote overall maternal wellbeing with the preservation of neonatal health. Lastly, the nitrous oxide education project required no additional funding to develop and ensured the staffing demands at FBCH were unchanged.

Organizing Framework

Our team utilized the Iowa Model as a framework for the safe implementation of this project. The hospital purchased the equipment and supplies to deliver nitrous oxide to parturients, therefore this project had high organizational support and met the criteria to form a team of Doctorate of Nursing Practice (DNP) students to guide implementation (White, Dudley-Brown, & Terhaar, 2016). Utilizing the Iowa model, our team conducted a thorough literature search and evaluated the evidence for strength, reliability, and feasibility of educational modalities. A pilot program was developed to translate and implement the recommended practice change. Aligned with the core concepts of the Iowa model, the process of achieving practice change and relevant outcomes was carefully evaluated during the pilot phase. In the Iowa Model, the final decision point is to determine if the intervention is appropriate for practice, and to take actions to sustain the change at FBCH. If not appropriate, the stakeholders are directed to continue to evaluate evidence to find a more suitable change; a new team will be generated to assess the current status of the literature and implement alternative interventions (White et al., 2016). The feedback loops and decision checkpoints allow for continuous cycling of the research-practice model until an effective, appropriate action is taken.

Project Design

General Approach

This project was an educational implementation (EI) design that utilized a pre-education and post-education assessment. We provided education and training to obstetrical staff regarding nitrous oxide as an analgesic option for parturients. We conducted pre-education and post-education knowledge assessments and formulated a plan with the Clinical Nurse Educator for education sustainment. Potential barriers to this EI were complexity to staff training opportunities and limited nitrous oxide utilization required for skill sustainment. We used online training modules to increase convenience and decrease staff burden prior to the in-person lecture, case scenario discussion, and hands-on skill practice.

We conducted in-person training over three days at shift changes to maximize staff availability; a training super-user facilitated education of staff unable to attend in-person opportunities. Training attendance is a prerequisite for nitrous oxide administration to patients, which is an additional incentive for staff training completion.

Setting

This multidisciplinary project took place within the Labor and Delivery and Anesthesia Departments at FBCH. This military treatment facility provides care to active duty, retirees, and beneficiary dependents in a region south of Washington, DC; staff assist in 1,577 deliveries annually (FBCH, 2018). This EI targeted staff members directly involved in parturient care: labor and delivery nurses, obstetrics staff (obstetricians, midwives), and anesthesia staff (anesthesiologists, nurse anesthetists).

Procedural Steps

Evidence evaluation. The CINAHL, Embase and PubMed databases were searched to gather data and articles for a review of the current literature addressing the best training methods utilized that yielded optimal staff knowledge retention, critical thinking and skill mastery. The CINAHL search combined the keywords “inservice” or “in-service” or “staff” and “models” or “educational” or “clinical competence” or “TI model” or “TI models” or “educational-model” or “educational-technique” or “clinical-competence.” The PubMed search utilized the keywords “inservice training/methods” or “inservice training/standards” or “staff development/methods” or “staff development/standards” or “staff development” or “staff training” or “inservice training” or “in-service training” and “model and educational” or “educational technique” or “educational model” or “model” or “models” or “clinical competence.” The Embase search combined “in service training” or “hospital personnel management” or “staff-development” or “staff-development” or “staff-training” or “in-service-training” or “inservice-training” and “educational model” or “clinical competence” or “model” or “models” or “educational-technique” or “educational-model.” The search was limited to all articles published after 01 January 2008 to include those published through 28 June 2018. Additional limitations included publications in English and peer-review completion. As of 28 June 2018, this search strategy resulted in 256 articles from PubMed, 127 from CINAHL and 176 from EMBASE, for a group of 559 results. A total of 67 articles were removed as duplicated to yield 492 unique articles for review.

The titles and abstracts of these 492 articles were reviewed with predetermined inclusion and exclusion criteria. Inclusion criteria included articles that evaluated a relationship between a training method and learning outcomes/skill performance in healthcare professionals. Articles selected for inclusion were then subject to the application of exclusion criteria including

dissimilar implementation timeframes (e.g., university curriculum, month-long courses, and three-day trauma course), training with no reporting on effectiveness, and articles not related to clinical scenarios (e.g., building a personal portfolio, career networking, and patient-centered health-care models).

After a preliminary review of all abstracts, 33 articles were determined to fit the inclusion and exclusion parameters for this literature search. After a full-text review, 23 articles were removed for content or methods inconsistent with the current search (e.g. editorial reviews, professional surveys). An in-depth analysis and appraisal was completed for the remaining 10 articles.

Educational intervention design. Our literature search yielded two main themes to maximize learning outcomes: the efficacy of multimodal strategy and the application of adult learning theory. According to integrative reviews of in-service healthcare training, interactive or self-guided methods (e.g., case study, simulation, discussion) facilitated the highest increase in knowledge retention, skill mastery, and critical thinking (Bluestone et al., 2013; Merchant, 2012). Interestingly, researchers have found that computer-based methods can be equally, if not more effective than in-person teaching (Toole, Stichler, Ecoff, & Kath, 2013; Bluestone et al., 2013). This may be explained by adult learning theory, which recognizes that adults utilize a wide array of learning strategies and comprehension occurs at various speeds; an online module allows learners to absorb information at a pace conducive to their needs (Parchen, Phelps, Johnson, & Fisher, 2016). Other implications of adult learning theory include multimodal strategies, self-guided modules, focusing on the real-life application of knowledge, and presentation of objectives for goal-oriented learners (Brimmer et al., 2008; Parchen et al., 2016).

Utilizing this available evidence, we designed a multimodal two-phase training program: an online module followed by an in-person workshop.

The online module was made available to all staff and presented a course overview, training objectives, and educational information on nitrous oxide, including administration concerns and clinical implications. This online module allowed staff to familiarize themselves with information before attending the in-person workshop, thereby impacting knowledge retention through repetitive exposure (Bluestone et al., 2013). Staff members then participated in an in-person workshop that focused on problem-solving and critical thinking through interactive, discussion-based didactic review and a case study analysis (Parchen et al., 2016). Additionally, hospital policies and patient educational materials were provided. We delivered this 30-minute training to all labor and delivery nurses and obstetric providers at four sessions during shift turnover over two days to maximize staff attendance. Charge nurses were identified as "superusers" to function as future trainers to new staff (see sustainment plan below). Anesthesia providers received in-person training that was tailored to their clinical role as subject matter experts. This was presented to anesthesia staff on a Tuesday morning during the weekly staff meeting. Our EI was designed to pair with an equipment inservice by the supplier and a high-fidelity simulation run by the Obstetric Department Clinical Nurse Specialists, both to be conducted after our project completed.

Implementation. The outcomes we measured encompassed staff knowledge and attitudes as benchmarks for clinical competency and comfort with patient education. Before implementing this program, a pre-education assessment was obtained from obstetrical staff, with a goal of capturing 80% of all nurses and providers currently working at FBCH (i.e., excluding staff on deployments and temporary duty yield). All staff received the same anonymous, pre-

education assessment materials: a multiple-choice test on nitrous oxide use and clinical management and a qualitative survey analyzing self-reported comfort with management and readiness to participate in patient education utilizing the 5-point Likert scale (1= least favorable, 5 = most favorable). Pre-education assessment results allowed us to establish a baseline with which to compare post-intervention results. The same assessment and survey were re-administered after the training to evaluate learning outcomes, staff attitudes, and overall readiness to implement the nitrous oxide labor analgesia program.

Plan for data analysis. We used descriptive statistics to analyze the effectiveness of the education intervention and evaluate responses to the pre- and post-assessment and a Level-of-Comfort Survey.

Dissemination. Data analysis identified the strengths and limitations of this project to share with key stakeholders and professional peers. Our dissemination plan included oral presentations to FBCH staff including obstetric leadership to discuss identified knowledge gaps and potential barriers with using nitrous oxide. Additionally, we shared successes and difficulties associated with this type of staff training with the Clinical Nurse Educator to guide future educational efforts. We also shared our results with our professional peers at the general poster session during the 2019 American Association of Nurse Anesthetists conference in Chicago, IL. Finally, we will present our findings during the annual Uniformed Services University Research Week in May 2020.

Sustainment. The obstetric staff need education after the initial nitrous oxide training program was piloted. Our solution to this issue was to designate labor and delivery superusers to oversee future training iterations; they will be overseen by the Labor and Delivery Department Clinical Nurse Educator. Additional sustainment measures included in this project were the

incorporation of the training modules into the annual online Elsevier training (a system used by the MHS to administer/track required training), newcomers nurse orientation, and hands-on skills training for labor and delivery nurses. A resource binder is maintained at the nurse's station on the Labor and Delivery Unit for reference by the staff.

HIPAA Concerns

Employee identification was not obtained on the pre and post-assessments mitigating any concern for a violation of the Health Insurance Portability and Accountability Act (HIPAA) during the implementation of this project. All data was stored on a common access card (CAC)-enabled computer in a locked, badge-accessed room, available only to project staff. All physical data (survey sheets) were stored in a locked cabinet. All physical data was shredded at the conclusion of this EBP project.

Legal and ethical implications. This Doctor of Nursing Practice (DNP) project involved the collection of data from staff members; no personally identifiable information or protected health information from patients or staff was accessed during this project, which mitigated any concern for a violation of HIPAA during implementation or data analysis. This project was submitted as an education improvement initiative and received a determination of not research (exempt from Institutional Review Board).

Project Results

Participation varied by both learning module and provider type: anesthesia providers (AN), obstetrics providers (OB), labor and delivery nurses (LDN). A breakdown of participation rates follows for the pre-assessment and online module versus in-person module and post-assessment, respectively: AN, 18% vs. 48% (n=9 vs. n=14); OB, 45% vs. 26% (n=24 vs. n= 14); LDN, 44% vs. 70% (n= 34 vs. n=54). A total of 41 participants (26%) completed both portions

of the educational intervention (EI) and took the pre- and post-assessment; AN n=7, OB n=12, LDN n=22. Prior to training, the pre-assessment median score was 73%, IQR 23. After training, the post-assessment median score was 92%, IQR 8; scores increased significantly from pre- to post-assessment, p value <0.001. A breakdown of individual staff groupings showed comparable increased pre- and post-assessment scores. The smallest change was noted in AN (21%) and the greatest score improvement was in LDN (29%).

Data from the pre- and post-intervention Level-of-Comfort Survey was collected from 36 staff members (AN = 11, OB = 11, LDN = 14) to gauge change in comfort with aspects of administration, management, and education regarding N2O for labor analgesia. The staff's self-reported comfort was divergent: overall comfort increased across all questions for AN and OB (34% and 62%, respectively), but decreased across all questions for LDN (12%). It is worth noting that the pre-intervention baseline level-of-comfort reported by LDN was the highest of all groups (3.6% vs AN 2.9%, OB 2.6%).

Analysis of Results

Although many of the staff had awareness of (or previously used) nitrous oxide for labor analgesia, there was a similar baseline knowledge deficit amongst all groups. The data indicated this EI was effective in addressing the knowledge gap and increased overall knowledge across all staff groups. In addition to objective measurements of learning, we also analyzed if there was an impact on the staff's comfort with the implementation of this new program. Post-intervention level of comfort decreased in LDN, the staff group that interacts most directly with the logistics, installation, monitoring, and bedside coaching for N2O. This may suggest that objective knowledge does not necessarily correlate to clinical comfort, especially when technical skills are involved. Additionally, given the relatively high LDN pre-survey scores (higher than either

provider group), our training may also have unmasked a pre-existing knowledge deficit or an inflated confidence of that knowledge, which led to decreased post-assessment comfort scores.

Organizational Impact/Implications to Practice and Policy

Our project showed that a two-phase training program utilizing self-guided and in-person components is an effective and feasible method to provide in-service education and raise objective knowledge. Trainers should consider the needs of staff when designing their program and tailor content to specific roles.

Implementation of a standardized training program for obstetrical staff on the utilization of nitrous oxide for parturient analgesia has moved FBCH closer to becoming a high reliability organization. Prior to this project, parturient options for labor analgesia included opioid intravenous agents, neuraxial anesthesia, or an unmedicated delivery. The FBCH Labor and Delivery leadership expressed a desire for the addition of nitrous oxide for labor analgesia. Therefore, there was a need for this educational intervention and the support to establish this project.

There were several limitations that may have diminished the impact of this training. There was low utilization of the online compared to the in-person training modules. This may be attributed to the voluntary and independent, self-initiated nature of the computer module versus mandatory training. Pre- and post-assessment results may not have been representative of the entire population due to a low completion rate of 30%. Additionally, our EI featured one standard training curriculum given to three different, highly-specialized groups of medical staff. An EI that was more tailored to the unique needs or role of the various groups may have affected greater impact on the staff's education and readiness for this new labor analgesia program (see above commentary on LDN level of comfort). The multiple-choice assessment questions were

reviewed by an expert panel, but there was no beta-testing of multiple-choice questions or surveys. Individual question performance analysis indicated a possible need to re-examine the training module content.

Future Direction for Research and Practice

Future projects should consider measuring secondary outcomes such as long-term knowledge retention and objective measurement of staff competency. This would contribute to a better understanding of the relationship between objective knowledge, self-reported comfort, and clinical competence. Inclusion of safety metrics (e.g., incidence of adverse events, equipment malfunctions, etc.) may illuminate how this training influences patient outcomes. Additionally, the inclusion of a patient survey regarding the management of their labor analgesia experience at FBCH would determine if patients were satisfied with the education and options they received.

Conclusion

Nitrous oxide is an alternative pain modality for parturients who desire a less invasive analgesic option or may have contraindications from receiving neuraxial anesthesia. The dilemma that was presented to this DNP group was that FBCH had acquired the equipment to initiate nitrous oxide usage, however, they lacked an appropriate training platform. An evidenced based educational intervention was developed and implemented at FBCH. This led to increased knowledge and comfort level for staff directly involved in the teaching and administration of nitrous oxide. Despite some limitations to this project, overall it demonstrated that a multimodal strategy composed of pre-course work and in-person case study/didactic review was an effective training method for the staff at FBCH.

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Appendix A
CITI Certificates

CITI PROGRAM

Completion Date 29-Aug-2017
Expiration Date 28-Aug-2020
Record ID [redacted]

This is to certify that:

Erika Papenfuss

Has completed the following CITI Program course:

OUSD P&R Human Research (Curriculum Group)
Biomedical Investigators and Research Study Team (Course Learner Group)
1 - Biomedical Investigators (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w4511cd5a-e35d-468d-8f9b-bc0e421f3afe-24340995

CITI PROGRAM

Completion Date 29-Aug-2017
Expiration Date 28-Aug-2020
Record ID [redacted]

This is to certify that:

Erika Papenfuss

Has completed the following CITI Program course:

Responsible Conduct of Research (RCR) (Curriculum Group)
Responsible Conduct of Research (RCR) (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w0710b0c4-e2e6-44a8-8a0c-32ca1933b7c2-24340997

CITI PROGRAM

Completion Date 25-Aug-2017
Expiration Date 24-Aug-2020
Record ID [redacted]

This is to certify that:

Amanda Vance

Has completed the following CITI Program course:

OUSD P&R Human Research (Curriculum Group)
Biomedical Investigators and Research Study Team (Course Learner Group)
1 - Biomedical Investigators (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w02c3af75-ccb8-412e-8f01-028e2bbde2cc-24297195

CITI PROGRAM

Completion Date 25-Aug-2017
Expiration Date 24-Aug-2020
Record ID [redacted]

This is to certify that:

Amanda Vance

Has completed the following CITI Program course:

Responsible Conduct of Research (RCR) (Curriculum Group)
Responsible Conduct of Research (RCR) (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Office of the Under Secretary of Defense (Personnel and Readiness)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w66190880-4a37-4daa-b585-f03ac1ee7f9b-24297197

Appendix B
Notice of Project Approval

USU
Uniformed Services University

OFFICE OF RESEARCH
4301 JONES BRIDGE ROAD
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PHONE: (301) 295-3303; FAX: (301) 295-6771

NOTICE OF PROJECT APPROVAL
Change Number: Original

VPR Site Number:	GSN-61-10900
Principal Investigator:	Vance, Amanda
Department:	Graduate School of Nursing
Project Type:	Student
Project Title:	Evidenced Base Training on Nitrous Oxide for Parturient Analgesia
Project Period:	10/8/2019 to 3/31/2020

Assurance and Progress Report Information:

Name	Sup	Approval Type	Status	Approved On	Forms Received
Progress Report	0			To be Submitted	N/A

Remarks:
This Notice of Project Approval has been reviewed and approved. Please remember that you must submit a final Progress Report (Form 3210) upon completion of this project.

Questions regarding this approval should be directed to the following person in the Office of Research:
Sharon McIver, (301) 295-9814.

[redacted]

Yvonne T. Maddox, Ph.D. Date
Vice President for Research
Uniformed Services University of the Health Sciences

cc:
File
CDR Kenneth Radford, PhD, CRNA
Laura Taylor

Appendix C
IRB/PI Letter of Determination

DEFENSE HEALTH AGENCY
FORT BELVOIR COMMUNITY HOSPITAL
9300 DEWITT LOOP
FORT BELVOIR, VIRGINIA 22060-5901

FBCH-RPCI 11 January 2019

FROM: Fort Belvoir Community Hospital (FBCH) Department of Research Programs (DRP) Determinations

TO: Amanda D. Vance, Capt, USAF, FBCH

SUBJECT: FBCH DRP Determinations Review of Project #909338; Reference #909338

PROJECT TITLE: "Nitrous Oxide Training For Obstetric Staff: An Evidence-Based Practice Project"

SUBMISSION TYPE: New Project

ACTION: Determination of Not Research—Evidence Based Practice (EBP)

DECISION DATE: 11 January 2019

1. Thank you for your submission of the plan, survey, and/or supporting materials for this project. A FBCH DRP Determinations Official has determined the activity as described is an EBP Project and does not meet the full definition of research as defined in 32 Code of Federal Regulations 219.102(d). Submission of an IRB research application is not required.

2. This project is Obstetrics initiative to develop and administer an evidence-based education and training program to increase obstetric staff knowledge, technical excellence, and comfort with the existing FBCH policy to offer nitrous oxide as an analgesic option to laboring women at this organization (FBCH).

3. Any changes to your project must be reviewed by a FBCH DRP Determinations Official to ensure that the changes do not impact this Determination.

4. Any publication(s) or manuscripts arising from this work must be submitted and cleared through the publication clearance process. Many journals are interested in publishing EBP projects. If you do decide to publish your EBP findings, please use paragraph headings such as "issue", "procedures for collecting and evaluating information", "information found", "lessons learned", etc. and avoid using terminology such as "research questions", "methods", "results", "study limitations", etc.

5. This is not an approval to receive extramural resources (i.e. personnel, drugs, supplies, equipment, money, and gifts from any source outside of FBCH). You must coordinate extramural resource approvals with the Office of Research and Technology Applications

(ORTA) at (301) 295-8239/8219. If any extramural resources are received without DOD or MEDCOM approval, the individual who receives them may be found in ethics violation and prosecuted for criminal misconduct.

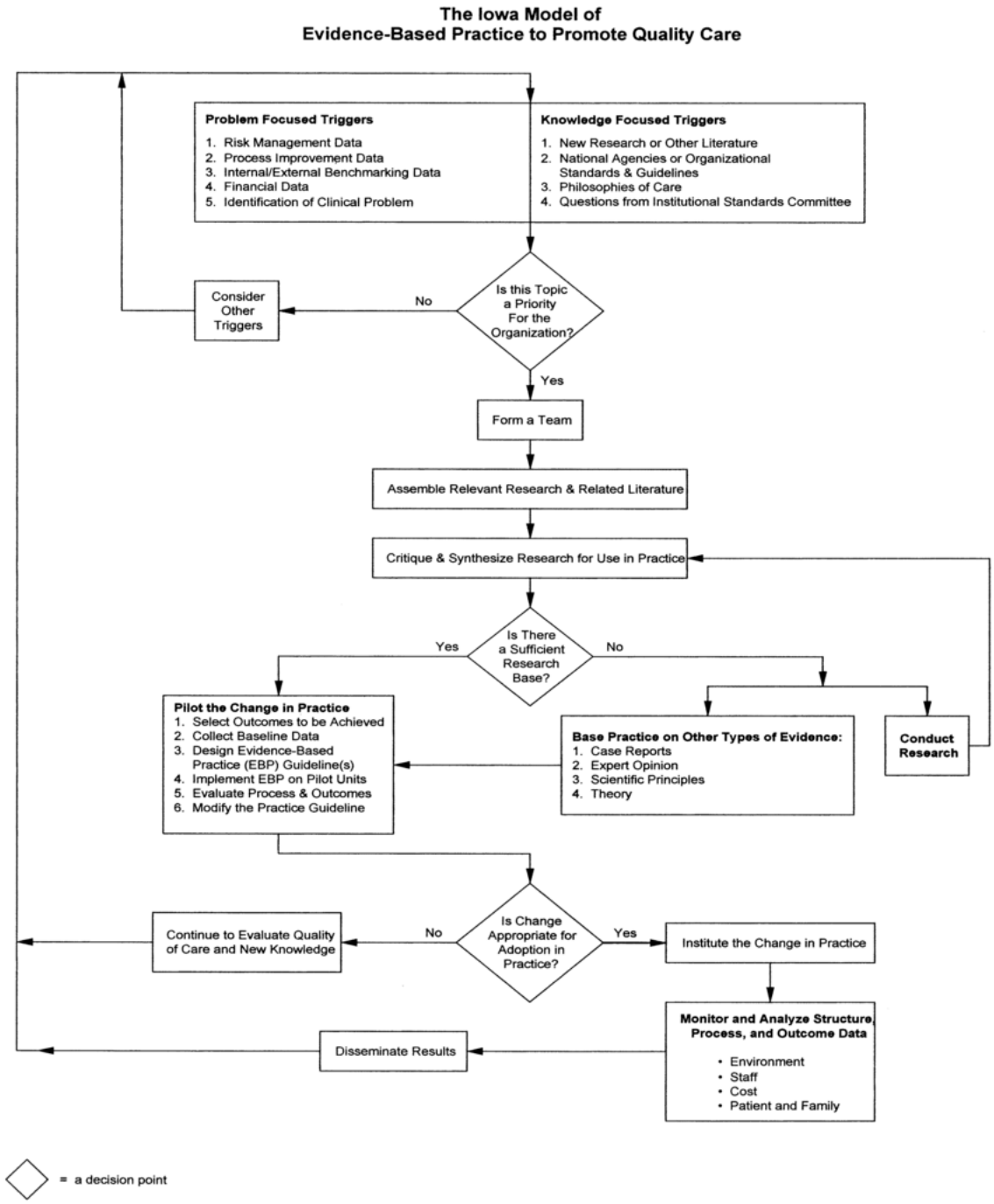
7. If the project involves standardized information gathering via instruments (including, but not limited to, a report form, questionnaire, interview, interview script, oral communication, report, survey, system, website, phone request/phone script, mailer, focus group, automated/electronic/mechanical/other technological collection technique, or other tool used to collect information"), the project may be subject to DoDD 8910 (Information Collection and Reporting) and the team leader has the responsibility to comply with any applicable rules or clearance procedures to assure approval.

8. You may begin your project pursuant to any appropriate FBCH Committee and/or Command approvals. At the completion of your project, you are required to submit a Closure Form in EIRB. Please remember that project data remain the property of FBCH and may not be removed without prior Command authorization.

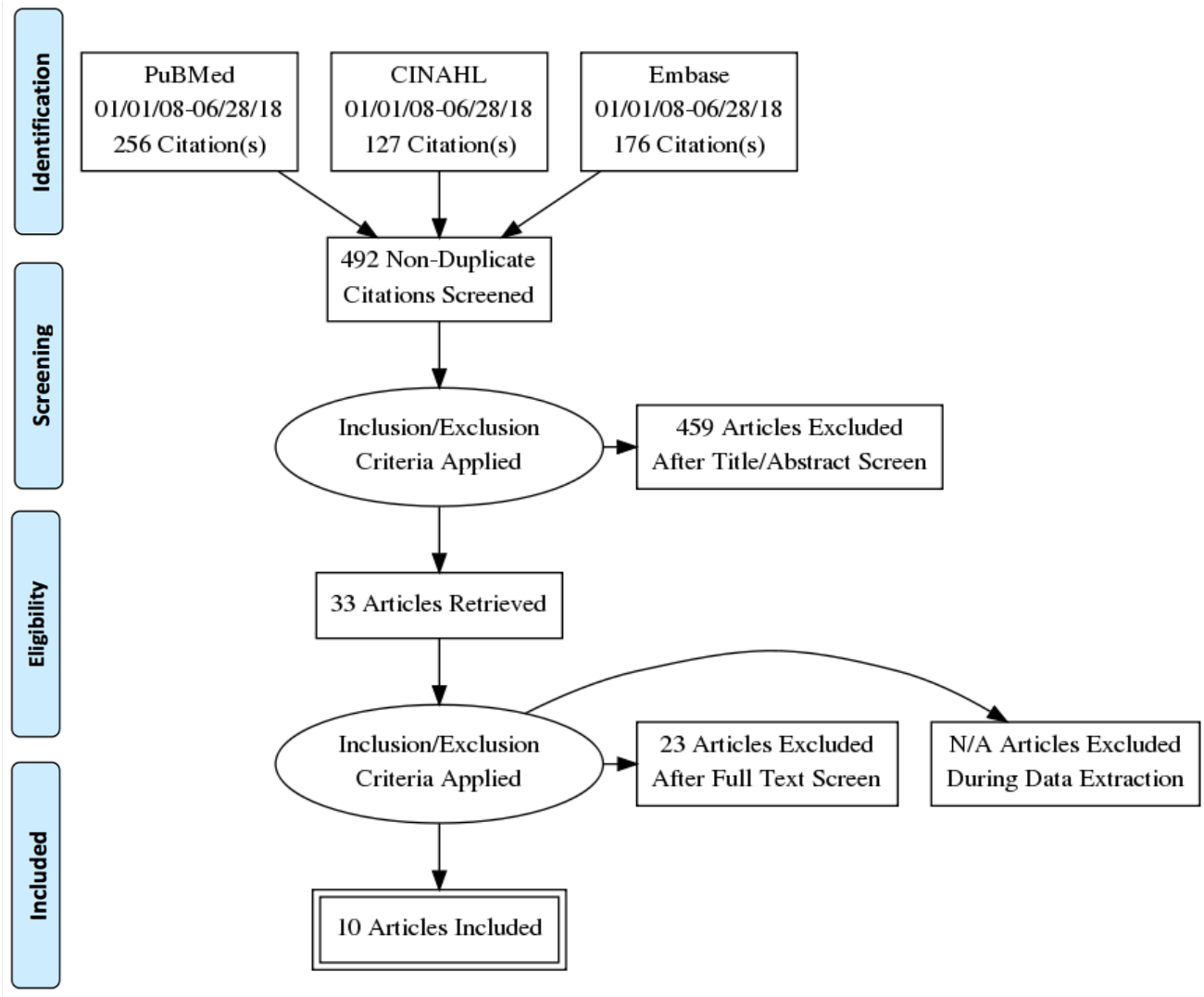
9. If you have any questions or concerns, the POC is Ms. Kristin Beltz at 571-231-2748. Please include your project title and project number (**909338**) in all correspondence with this department.

KRISTIN BELTZ
DOD CIV
Determinations Official
DRP, FBCH

Appendix D
Organizing Framework



Appendix E
PRISMA Diagram



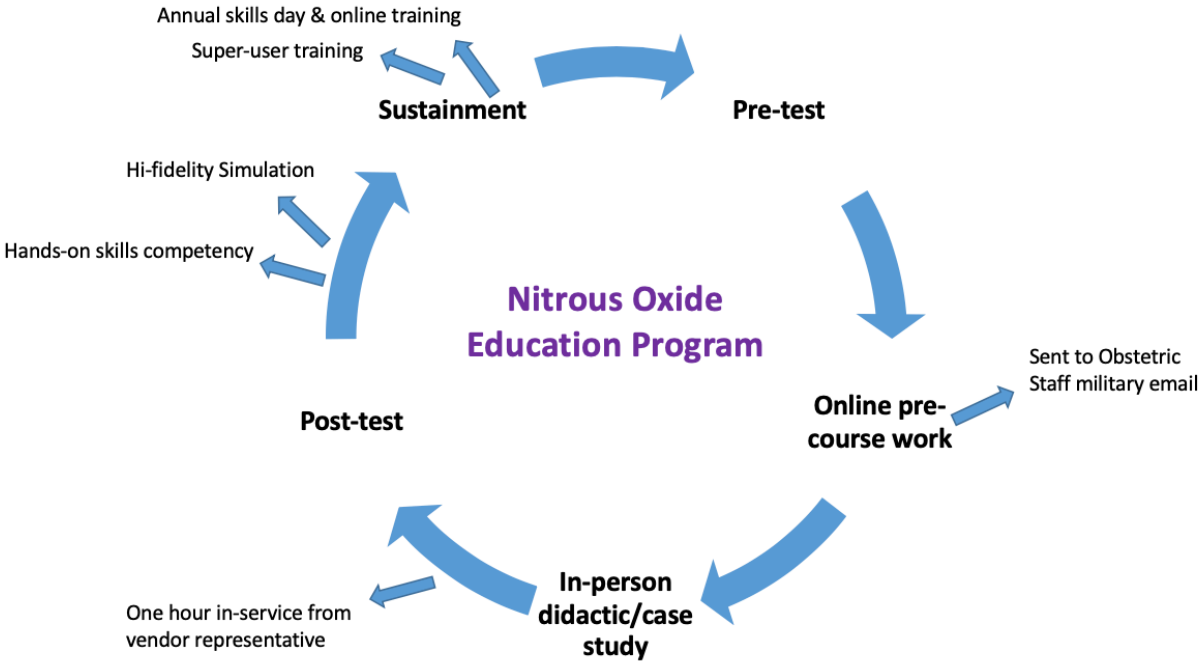
Appendix F
Table of Evidence

Source	Study Design & Grading	Purpose/ Clinical Problem Addressed	Outcomes Measures	Study Setting & Population	Summary of Interventions	Key Findings
Bluestone et al (2013)	Level IIA (integrative review) high quality: articles selected for analysis after two quality reviews consisted of systematic reviews, randomized controlled trials, clear research and evidence appraisal, logical discussion of results and thorough review of limitations	ID the evidence addressing best practices in the design and deliver of in-service training interventions	Case-based: use of created or actual clinical cases that present materials & questions Didactic/lecture: presenting knowledge content; facilitator determines content, organization and pace Feedback: providing information to the learner about performance Games: competitive game with preset rules Interactive: provide for interaction between the learner and facilitator Point-of-care (POC): information provided as needed, at the point of clinical care Problem-based learning (PBL): present a case, assign information-seeking tasks and answer questions about the case; can be facilitated or non-facilitated Self-directed: completed independently by the learner based on learning needs Team based: providing interventions for teams that provide care together Frequency: comparing single versus repetitive exposure Media: Live vs computer based	69 studies, including 37 systematic reviews; 32 RCTs; multiple settings	See Bluestone et al (2013) for full resutls breakdown for each training intervention	Case-based: postitive learning outcomes with the use of live standardized patient and a computer-based virtual patient Didactic/lecture: was not found to be an effective educational technique compared with other methods Feedback: key for effective skill development Games: could have a positive effect (inconsistent results) Interactive: interactive techniques moderately superior for knowledge outcomes than didactic lecture; 3 systematic review/1 meta analysis describe importance of learner interactivity in achieving positive learning outcomes Point-of-care (POC): Handheld devices more effective than print-based; support via video using a mobile device vs only didactic instruction Problem-based learning: one study ID'd as slightly better and two studies indicate relatively equal to didactic instruction; several reported increased critical thinking skills and confidence in making decisions Reminders: using mobile devices for repetitive reminders resulted in knowledge retention Self-directed: utilization of computer as medium can be useful; stong support for simulation training and promoted psychomotor and communication skill development Team based: limited support for this method Frequency: All support the use of repetitive interventions; internet-baseed medium that uses repeated questons and targeted feedback; repetitive, time spaced education exposures results in better knowledge outcomes Media: support the use of computer based training for knowledge; importance of interactivity too
Brimmer et al (2008)	Level IIIB (case study) "High" quality: methods/purpose are clear and detailed. Study has logical discussion of results and thorough review of limitations	Train the trainer workshop (2 day course delivered) and then those staff delivered training at secondary presentations. As core trainers, the workshop participants were expected to show increases in knowledge, self-efficacy, and management on Chronic Fatigue Syndrome (CFS)	Knowledge and self-efficacy: Course evaluation and assessment with Likert scale (1-5), Opinion survey with 5 ratings, CFS attitudes test, and a pre- and post-knowledge test	health care providers from six states: North Carolina, Texas, Florida, Oklahoma, Washington, Utah via invitation. Screening process completed to ensure they could follow through on commitment to train colleagues	Data on Primary Care Opinion Survey ($p < 0.01$) and on Relevance and Responsibility Factors of the CAT survey ($p=0.03$ and $p=0.04$). Significant change on pre- to post-test score on the CFS knowledge test ($p=0.001$)	Workshops followed a format including introduction session followed by didactic presenations, case study review, small group breakout, and presentation practice session. Individuals learned how to use educational model presented and agreed to present one to two hour programs to groups of their peers.
Guadagnin et al (2016)	Level IIIB (case study) "good" quality: Sufficient sample size for design, fairly consistent findings, limitations addressed, literature search vague	Nutrition knowledge questionnaire validation; evaluate the effect of an interactive or a lecture-based education program on nutrition knowledge	Validate a nutrition knowledge questionnaire (NQ) and its utility in evaluating changes in knowledge among participants	6 workplaces conducted education program and used nutrition knowledge questionnaire to evaluate changes in knowledge among participants	interactive vs lecture-based education program	increase in NQ scores was significantly higher in the interactive group than in the lecture groups ($p=0.008$)

Hulse et al (2013)	Level IIIB (case study) "good" quality: method and results section is clear. Some general conclusions made fails to mention limitations.	To discuss appropriate assessment tools for clinical competency assessment and what assessment tool is best for assessment of IV therapy/vascular access	Questionnaire on nurses views of clinical competency assessment with Likert scale (1-5), opinion survey on usefulness of other clinical competency tools	35 randomly selected registered nurses	Clinical competency skills checklist vs other types of assessment tools	Clinical skills assessment are essential, Objective Structured Clinical Examinations is another tool believed to be useful to assess IV therapy
Jankouskas et al (2008)	Level IIIC (case study) "low" quality: Does not report the number of staff involved in study and does not report limitations in study design. Does provide results and practice application but vague details on how these results can be determined	Use of self-goverance model and evidenced-based approach to learning to enhance hands on competency skills; one-hour competency training	List of four to six subskills or knowledge for each competency (chest tubes, resuscitation cart, dialysis machine, insulin pen, patient-controlled analgesia pump, urimeter, the externalized ventricular shunt, and apnea monitor)	unit staff of one department; does not report what department or how many staff involved	Educational needs of unit determined by council members and clinical nurse specialist (CNS), Core competencies developed, council choose return demonstration, and detailed review of competencies served as a train-the-trainer session. Prior to skills checkoff, self-directed study was the primary method and checkoff included positive feedback from staff and observation by peers.	Competency completion without cueing from the council member was documented as a plus sign, whereas competency assistance was documented as a minus sign; results reported for clinical competenies.
Kennedy et al (2012)	Level IIB (systematic review) "good" quality: Results reported and credible conclusions that have relevant application to project. Literature search section was brief and limitations not addressed	To determine what different training methods are being used for nurse orientation programs with the aim to identify best training methods for knowledge retention and patient outcomes	Identification of teaching strategies and outcomes of general nursing orientation with focus on delivery, teaching strategies, and outcomes for nurses.	systematic and integrative review of over 2000 articles	Systematic review of current orientation programs training methods vs more effective training methods (interactive slide shows, simulation-based, active praticipation, incoporation of informatics)	Providing a strong, adult learner-focused orientation can increase nurse retention by 90%. Evaluation of current training (didactic, individual study, learning contracts) reported half of nurses feeling unprepared to provide safe patient care
Madah-Amiri et al (2016)	Level IIIB (case study) good quality: clearly stated purpose, limited literature review, unclear if survey was validated, no inclusion of survey questions, limited results discussion, appropriate acknowledgement of limitations, reaosnable recommendations for applicability of results and implications for future study	to assess effectiveness of an educational method to train large numbers of trainers on naloxone administration as part of national overdose prevention strategy	questionnarie pre- and post-implementation: assess participant's knowledge on naloxone, attitudes towards training session,	Norway: low threshold facilities, healthcare staff n=54 (healthcare staff, all educational levels)	rain-the-trainer model: central trainer trains others, who can then train others in a target population. participants already working in target field, primed to carry out intervention once trained. 2 hour course developed utilizing focus groups for content: background, physiology and signs of overdose, mechanism of action of naloxone, clinician response to overdose, proper administration of naloxone, documentation.	- Opioid Overdose knowledge scale (multiple choice test): scores improved: $p<0.001$ - Trainer attitude survey on 1-5 Likert scale: understanding and comfort teaching others about overdose, response, andpreparedness/ confidence to teach others: signficant increase in all areas ($P<0.001$): self-reported understanding on content, preparedness to respond to an overdose, comfort teaching others. limits: need long-term results analysis of subsequent training sesison involvement, actual knowledge transferred to clients vs self-reported confidence to do so

					course methods: powerpoint lecture, hands-on skills session.	
Madenci et al (2016)	Level IIA (systematic review) high quality: combination of RCTs & quasi-experimental studies (2-group cohort studies), clear research and evidence appraisal, logical discussion of results and thorough review of limitations	to assess the real-patient procedural success of simulation training for central venous access	primary: proportion of trainees demonstrating ability to successfully complete the procedure; secondary: number of attempts, periprocedural adverse events	5 (3 RCTs, 2 cohort studies)	simulation vs. appreceniceship/lecture training	high-fidelity sim with larger percentage of first-time success rate ($p<0.01$), no significant difference in adverse event rates
Merchant et al (2012)	Level VB (literature review) "good" quality: draws fairly credible conclusions with logical arguments - limited review of included studies' quality; inconsistent reporting of results/data, failure to state data published with original studies	-to assess link between high-fidelity, scenario-based simulation education and clinical performance outcomes	clinical performance outcomes: competency, teamwork, crisis management	8 studies	-literature review: studies evaluating high-fidelity scenario-based simulations & performance outcomes among nurses in hospital settings >> Cinahl Plus, Cochrane, Academic Search Premier, OmniFie, PsychINFO, PubMed, Wiley Interscience: "nursing education, simulation, high-fidelity, learning, clinical outcomes, teamwork, crisis management" 2004-2010	-case studies on high-fidelity sim for low-incidence, high-risk scenarios: positive effect on time to task completion, ability to correctly perform task, patient outcomes (i.e. survival rates s/p pediatric codes), staff perceptions on ability to manage clinical crises, role confidence
Toole et al (2013)	Level IB (RCT) "good" study design, but no details on actual EI; conclusions don't seem c/w results...claim a statistical diff between pre-posttest but don't report p-value	-baseline knowledge, attitude, practice of EBP -effect of an EI on EBP survey & core knowledge -is there relationship between knowledge, attitude & practice?	-core knowledge via 8-question MC test -Upton&Upton 2006 EBPQ (knowledge, attitude, practice of EBP) -intervention group: n=130 -control group: n=192 (CBL), n=274 (in-class)	California hospital system: inpatient nurses. computer-based vs. in-class education	computer based vs in-class EI; participants selected code # to ID results for pre-post comparison	-no statistical diff between computer vs in-class EI on core knowledge or survey findings -survey: # CB-EBP courses correlated ($p<0.01$) w/ "own readings", professional organization bulletins/newsletters read, conferences attended

Appendix G
Educational Intervention Project Design



Appendix H

Nitrous Oxide for Labor Analgesia Competency Validation Test

1. Nitrous oxide gas is:
   - **a. commonly known as "laughing gas"**
   - b. highly flammable
   - c. often bitter tasting to many patients

2. Possible side effects for women using nitrous oxide for labor analgesia include:
   - a. headache
   - b. loose stools
   - **c. nausea and vomiting**

3. Nitrous oxide for labor analgesia is most commonly used at which concentration ratio?
   - a. 40 percent nitrous, 60 percent oxygen
   - **b. 50 percent nitrous, 50 percent oxygen**
   - c. 60 percent nitrous, 40 percent oxygen

4. All of the following patients are appropriate candidates for nitrous oxide analgesia ***EXCEPT*** the woman:
   - a. in labor who had butorphanol (Stadol) 3 hours ago and now needs a 3° laceration repair
   - **b. in labor with multiple sclerosis who has very limited grasp ability**
   - c. undergoing manual removal of her placenta following a spontaneous vaginal birth

5. For nitrous oxide to be most efficacious, a laboring woman should be encouraged to begin inhaling the nitrous oxide:
   - a. at the beginning of the contraction
   - **b. thirty seconds prior to the start of the contraction**
   - c. two minutes prior to the start of the contraction

6. The provider or nurse can be confident the patient education has been effective when the laboring woman states:
   - a. "I am concerned the nitrous oxide can keep my baby from taking his first breath."
   - b. "If I can't hold my mask while pushing, it's OK for my partner to hold it for me."
   - **c. "I understand that the relief provided by the use of nitrous oxide is different from the type of relief provided by an epidural."**

7. Patient safety while nitrous oxide is in use includes the provider or nurse doing what?
   - a. Making sure the support person knows how to hold the face mask with a tight seal.
   - **b. Observing and assisting the patient getting out of bed and moving about her room.**
   - c. Teaching the patient that birthing balls, hydrotherapy and squatting are contraindicated.

8. According to the authors, nitrous oxide:
    a. does not cross the placenta
    b. has an 80 percent clearance rate through the maternal/fetal circulation
    c. has been demonstrated in several studies to have no negative effect on either Apgar scores or neonatal behavioral scores

9. Nitrous oxide may be a beneficial analgesia choice for laboring women who:
    a. are not candidates for lumbar epidural analgesia because of spinal malformations or hematological disorders
    b. have altered absorption or insufficient dietary intake of B12 resulting in B12 deficiency
    c. have recently undergone intraocular surgery, bowel obstruction or middle ear surgery

10. Staff safety from exposure to nitrous oxide can be optimized by all of the following **EXCEPT**:
    a. having well-ventilated labor and delivery rooms
    b. using a scavenging system that collects exhaled nitrous oxide for disposal
    c. verifying greater than 100 ppm of nitrous oxide present in the ambient air

11. Which is the most accurate statement regarding the perception of pain relief by laboring women using nitrous oxide? They:
    a. have less pain than women who have epidural anesthesia for labor pain
    b. usually have more pain than women who use no pharmacological pain interventions
    c. generally will be satisfied with their labor experience

12. A woman arrives at the hospital with her cervix dilated to 7 cm and progresses rapidly to complete dilation. She had desired an un-medicated labor and birth, but is now screaming that she needs something for pain. In relation to this situation and pain relief, which is a true statement?
    a. An epidural placement would be the best mode of pain relief at this point.
    b. It is too late in labor for her to use nitrous oxide.
    c. She is a candidate for nitrous oxide use at this point.

13. Which of the following is a contributing factor to the resurgence of nitrous oxide use in labor?
    a. A growing demand by women and providers for more interventions during labor.
    b. Epidural anesthesia causing a statistically significant increase in the cesarean rate.
    c. Women's desire to have more options for pain management

Appendix I
Likert Survey

Nitrous Oxide Labor Analgesia Level-of-Comfort Survey

Please circle one per question to indicate the best response:

1	2	3	4	5
Very Uncomfortable	Somewhat uncomfortable	Neutral	Somewhat comfortable	Very Comfortable

1. If you had to teach a patient about nitrous oxide, how comfortable would you be?

1 2 3 4 5

2. If you had to train a coworker on nitrous oxide, how comfortable would you be?

1 2 3 4 5

3. What is your level of comfort in initial administration of nitrous oxide for parturient analgesia?

1 2 3 4 5

4. What is your level of comfort in managing nitrous oxide for parturient analgesia?

1 2 3 4 5

Appendix J

DOCTOR OF NURSING PRACTICE PROJECT
Completion Verification Form

The DNP Project titled: Development of an Evidence Based Practice Training Program for the Utilization of Nitrous Oxide for Parturient Analgesia at Fort Belvoir Community Hospital was completed at Fort Belvoir Community Hospital by the following student(s):

(type student name)	*(signature)*	*(date)*
Erika Papenfuss	[redacted]	26March2020
Amanda Vance		26March2020

The DNP Practice Project Team verifies that the following components of the DNP project, accomplished by the above students, is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation:

- Presentation of DNP project to the leadership/stakeholders at the Phase II Site,
- Abstract/Impact Statement (*Appendix F*), and
- DNP Project written report.

Verified by:

(type name)		*(date)*	
Sandra S. Bruner	[redacted]	3/27/20	Senior Mentor
LTC William T. Sellers		3/27/20	Team Mentor & Phase II Site Director

For RNA Students only *- add the following additional signature for final verification of project completion:*

CDR Ken Radford, PHD, CRNA	[redacted]	27 MAR 2020
RNA Project Director *(type name)*		*(Date)*

Form Version: 26 Aug 2017