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Evidence-Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic Toxicity) Response Protocol

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Title of DNP Project:

Evidence-Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic Toxicity) Response Protocol

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Submitted in partial fulfillment of the requirements for the Degree of Doctor of Nursing Practice.

**Evidence-Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic
Toxicity) Response Protocol**

A Doctor of Nursing Practice Scholarly Project

Presented to the Faculty of the
School of Nursing and Health Sciences

La Salle University

In Fulfillment

Of the Requirements for the Degree Doctor of Nursing Practice

By

Katie Gillespie and Kathleen Snavelly

Doctor of Nursing Practice Program

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Abstract

Local anesthetics are widely used in practice to control patients' pain; however, local anesthetic systemic toxicity (LAST) is a potentially fatal risk factor that may occur after local anesthetic administration. Evidence-based education for providers could prevent the deaths of patients by increasing knowledge of pathophysiology, identifying varying signs and symptoms of local anesthetic toxicity, and implementing timely treatment. This doctoral project created an evidence-based teaching plan to educate perioperative providers on how to identify and more effectively respond to LAST.

Keywords: local anesthetics, toxicity, LAST

Evidenced Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic Toxicity) Response Protocol

Background

Local anesthetic systemic toxicity (LAST) is an adverse outcome that may occur after a patient receives local anesthetic drugs. The effects may include central nervous system and cardiovascular toxicity (El-Boghadly et al., 2018). Weinburg et al. (2020) emphasized the importance of identifying risk factors of LAST, early recognition of symptoms, and precise intervention based on the presenting features. Early recognition, along with proper and prompt treatment, could be lifesaving (Wadlund, 2017).

LAST is estimated to occur in 1 out of every 1000 local anesthetic administrations (Antel & Ingelmo, 2022). These cases may occur in hospitals (61%) or in outpatient settings (14%) (Antel & Ingelmo, 2022). Local anesthetics are commonly used to provide effective pain relief with minimal risk factors; however, LAST remains a potentially fatal complication (Gitman & Barrington, 2018).

Several risk factors contribute to the development of LAST, making it difficult to completely prevent it from occurring. The ultimate goal for providers should be to recognize and reduce the risk factors associated with LAST as well as reducing its incidence and progression. Factors that predispose a patient to LAST are hypoxia and acidosis, while heart disease, reduced ejection fraction, mitochondrial dysfunction, liver disease, and kidney disease are comorbidities that increase the risk of LAST (Weinberg et al., 2020). The expanding use of local anesthesia and susceptibility of the aging population suggests an increase in the occurrence of local anesthesia toxicity in the future (Weinberg, 2019).

Numerous evidence-based LAST protocols are available for the perioperative provider. The Association of Anesthetists of Great Britain and Ireland and the American Society of Regional Anesthesia and Pain Medicine provided the first protocols for LAST treatment in 2010. These respective organizations have modified the protocols to reflect the best evidence-based practice (Weinberg et al., 2020). These protocols are accompanied by cognitive aids, such as algorithms and checklists, to utilize when treating patients with LAST. Emergency situations in the perioperative setting create stressful circumstances that can impair a provider's memory and cognitive function (Swerdlow & Osborne-Smith, 2023). Cognitive aids provide an organized model that guide practitioners towards appropriate life-saving actions. This makes it easier to recall information and organize thoughts to directly solve the problem and prevent mistakes (Swerdlow & Osborne-Smith, 2023). Emergency manuals and cognitive aids have been proven to improve actions, catch errors and provide important details for diagnosis and treatment (Goldhaber-Fiebert et al., 2020). For this reason, it is imperative that anesthesia providers are educated on when and how to utilize cognitive aids.

Problem Statement

According to several studies, healthcare providers have a significant knowledge deficit related to the basic pathophysiology, assessment of the signs and symptoms, and implementation of proper treatment protocols for LAST (Ferguson et al., 2019; Ferry & Cook, 2020). Without increased knowledge of the risks and serious adverse outcomes of LAST, including mortality, health care providers may miss opportunities to assess and treat patients experiencing this toxicity (Gitman & Barrington, 2018).

Due to its rarity, healthcare providers have little experience with LAST, leading to a lack of recognition (Wadlund, 2017). Since LAST is encountered infrequently, knowledge gaps may occur with clinician recognition, reporting, and implementation of effective treatment protocols. Because the incidence of LAST has been noted to be as low as 1 to 1.8 per 1,000 cases, it is common for providers to not have had experience with patients exhibiting LAST (Aldwinckle, 2021).

Purpose Statement

The project directors (PDs) of this Doctor of Nursing Practice project created an evidence-based teaching plan to educate perioperative providers on the risk factors, signs, symptoms, and current treatment protocols for LAST. Upon implementation, this project will provide a teaching plan on how to access and use existing cognitive aids to improve the implementation of existing resources and reduce reliance on providers' recall of LAST-oriented material, which will reduce misdiagnosis or mistreatment of LAST (Sanchez & Huang, 2020).

Project Question

What are the components of an evidence-based teaching plan for perioperative providers caring for patients at risk for LAST? Initial content areas address symptom recognition, pathophysiology of LAST, treatment algorithms, and accessible cognitive aids.

Conceptual Definitions

The following descriptions provide conceptual definitions used in this project:

- *LAST* is defined as cardiovascular and central nervous system complications resulting from local anesthetic injection (Aldwinckle, 2021).

- *Teaching plan for LAST* is defined as an evidence-based structure to improve provider knowledge, recognition, and treatment of LAST in the perioperative settings (Weinberg et al., 2020). The structure of this plan will include 1) objectives, 2) content, 3) teaching methods/techniques, 4) resources/materials, and 5) timeframe. The teaching plan can be repeated at regular intervals to maintain anesthesia providers' competence of identifying and treating LAST.
- *Knowledge of signs and symptoms of LAST* is defined as identifying characteristics or typical indicators of a LAST event by identifying and reporting an array of signs and symptoms involving the cardiovascular and central nervous systems (Weinberg et al., 2020).
- *Perioperative providers* for the purpose of this project will include Anesthesiologists, CRNA's, and registered nurses working in pre-operative, intraoperative and post-operative settings (Ferguson et al., 2019).

Review of Literature

PICO Question

The objective of this systemized review of literature was to determine the need for an intervention: an evidence-based teaching plan for perioperative providers caring for patients at risk for LAST in the perioperative setting. The PICO question is: What are the evidence-based educational contents required for a teaching plan for perioperative providers caring for patients at risk for LAST.

Population/Problem: Lack of education and knowledge related to LAST.

Intervention or Issue of Interest : Evidence-based teaching plan on symptom

recognition, pathophysiology, treatment algorithms and accessible cognitive aids for LAST.

Comparison: Current literature on LAST.

Outcome: An evidence-based educational teaching plan for LAST.

Search Strategy

The initial search process revealed 1,129 articles from 6 databases, including Cochrane Library, CINAHL, La Salle's Summons, Medline, PubMed and Proquest (See Table 1). Keyword search terms included: LAST, local anesthetic systemic toxicity, teaching, education, anesth* with Boolean operator AND in order to acquire relevant data. Delimiters included: English language; full text; peer reviewed; 2018-2023.

Duplicate articles were removed. Studies were appraised using the Johns Hopkins Nursing Evidence-Based Practice Tool and analyzed in matrix format (See Table 2).

Empirical Literature

Ferguson et al. (2019) conducted an evidence-based practice project design to evaluate and improve nurses' understanding of LAST. The authors of the study identified a lack of knowledge of best practice related to local anesthetics and LAST in perianesthesia settings. The design of this study was an evidence-based project design based on a modified Iowa model. The sample included 70 nurses in a 292-bed hospital in Northern Idaho working with and assisting CRNAs and Anesthesiologists in perioperative areas as well as outpatient settings and labor and delivery. A 10-question test was developed by CRNAs and physicians based on current literature related to pathophysiology, signs and symptoms and treatment of LAST. A 30-minute educational program was developed that educated the nurses on LAST events, signs and symptoms,

and treatment including lipid emulsion therapy. The 10-question test was given before and then after the educational program to compare scores as well as a survey measuring comfort level with LAST events on a scale of one to five. Due to the small sample, the authors summarized data using interquartile range (responses corresponding to 25th and 75th percentiles).

All nurses in the study showed an increase in comfort level with LAST events from the pretest to posttest after the education interval. The median post education scores were 100% in all of the nursing units and the outpatient and perioperative samples. The authors determined the change in comfort level and posttest scores to be statistically significant ($p < 0.0001$). One limitation of this study was that it was limited to one regional hospital with selective units and one outpatient surgery center setting. For this reason, a conclusion cannot be made that this study will apply to all nurses. As a result of this study, the authors determined that education related to LAST events is critical to gain and maintain competency among perianesthesia nurses. Although LAST incidence is rare, education related to pathophysiology, signs and symptoms and treatment can potentially save a patient's life during a LAST event (Ferguson et al., 2019). The authors determined that the didactic education given to the nurses in this study was effective to improve posttest scores, but that knowledge retention is still a concern. They recommend that annual LAST simulations and educational in-service programs be developed to reinforce knowledge.

Bevil et al. (2020) conducted a simulation-based study to evaluate knowledge retention related to LAST after a short educational session. A 20-question multiple choice pretest was given that included knowledge based questions created by two regional

anesthesiologists, one regional anesthesiology fellow and one pain management program director. Participants were then briefed on a clinical scenario and oriented to the simulation environment by simulation specialists. A SimMan display screen with vital signs, intravenous infusion set, oxygen device and mock code cart were included in the simulation. The scenario was that the participants were preoperative nurses receiving handoff on a patient who had received local anesthetic for a paravertebral block before mastectomy surgery. The patient develops symptoms of LAST including tinnitus, metallic taste and lethargy before experiencing ventricular fibrillation arrest with successful resuscitation from lipid emulsion therapy treatment. A formal debrief and educational lecture followed the simulation as well as the 20-question posttest. The posttest was distributed 1 month and 3 months after the simulation and included questions related to stress, self-efficacy, change in skill level, and comfort in crisis management. 13 nurses were from preoperative, post-anesthesia and the block nursing team at the University of Wisconsin Hospital. Participation was on a volunteer basis and each nurse was given a random identification number. The primary outcome measure was test performance over time using mixed-effects regression and modeling test performance as a function of assessment time. There were four-level factors: pre-simulation, immediately post-lecture, 1 month and 3 months post-simulation.

The average pretest score was 52% with a 95% confidence interval 0.45-0.58. There was significant improvement in test scores on immediate post-test scores (90%), 1 month post-simulation (81%) and 3 months post simulation (77%). There was statistical significance ($p < 0.0001$) between pretest and post-test scores, between pretest and 1 month scores, and between pretest and 3 month scores. Limitations of the study included

lack of a control group and lack of long-term follow up. The authors noted that the 3 month follow up scores were encouraging for knowledge retention, but that further follow up after 1 year was unknown. The authors also recommended a repeat in the educational experience every 12-18 months for knowledge persistence and recommended further research into longitudinal research on patient outcomes related to LAST.

Ferry and Cook (2020) implemented and evaluated the benefit of an interactive web-based educational self-learning module based on identification and management of LAST. An assessment of learning needs was performed at an acute care hospital to determine the nurses' level of knowledge of LAST signs, symptoms, and treatment. An initial discussion with a small group of 40 nurses was performed, followed by a formal learning needs assessment electronic mail blast to more than 2,000 nurses. Questions were focused on defining, identifying, and treating LAST. The four multiple choice question survey received 405 responses. Utilizing the Knowles adult learning theory and logic model, an interactive web-based educational self-learning module was developed. There were 4 modules based on identifying the signs, symptoms, and treatment of LAST with two patient experiences where death resulted due to the administration of local anesthetic. The goal of the training was for 70% of nurses to identify signs, symptoms, and treatment of LAST. An evaluation survey focused on the comprehension of the content and a 6 month survey evaluated the retention of content. Throughout the process, a lack of availability of patient education was identified. Patient education was designed and available in an electronic form. At the time of discharge, nurses were encouraged to print and disperse the information to patients and their families, and utilize the teach back method to confirm comprehension.

The study yielded 1,582 nurses completing the web-based educational self-learning module, of which 369 completed the post education survey questions. The goal of 70% of nurses correctly identifying the signs, symptoms, and treatment of LAST was exceeded with 76% and 75% respectively. The limitations of the study include the varied sample size of pre-, post-, and 6-month re-evaluation surveys, and only one method of delivery to disseminate the surveys. For future research, multiple modes of delivery, such as texting, could increase participation in the surveys and should continue to determine long-term outcomes. Annual web-based educational models are encouraged to maintain knowledge, signs, symptoms, and treatment of LAST.

Jamaleddin Surani et al. (2022) assessed awareness and knowledge of local anesthetics and LAST among postgraduate trainees at a medical center. A questionnaire assessed the awareness of LAST prior to and following (pre- and post-test) an hour-long medical education session. The questionnaire utilized 15 questions with 6 key questions (“must-know”) to be answered correctly for the trainee to be considered adequately “aware” of LAST. The data claims of increased awareness are based on “must-know” questions. A total of 133 postgraduate trainees participated in the study, with experience in using local anesthetics. The pre assessment proved LAST awareness overall to be poor. Anesthesia trainees had the highest awareness (45.5%), while surgical, orthopedic and OBGYN reported no awareness of LAST. There was significant improvement in average total scores of awareness.

Jamaleddin Surani et al. (2022) revealed that a single educational session can significantly improve awareness about LAST among postgraduate trainees. Multiple

educational sessions, with varying techniques are recommended. This study did not assess the long-term effect of a single educational session.

Aydin (2022) aimed to measure the level of knowledge regarding the systemic toxicity of local anesthetics. A total of 196 participants from different hospitals answered a web-based questionnaire. 56.1% of participants answered “yes” to having knowledge of LAST, 24% answered “no,” and 19.9% of participants “did not remember.” In regards to treatment, 74% of participants said to stop the administration of local anesthetics, 84.2% said airway safety needed to be secure, 65.3% said to call for help, 100% said to administer oxygen, 65.3% said to call for help, 66.3% said to open a safe venous line, 30.1% said that convulsions should be treated, and 51% said a 20% lipid solution should be administered. The collected data were analyzed using IBM SPSS Statistics 25.0 using descriptive statistical methods (number and percentages). Chi-square analysis was used to test the relationships of categorical variables.

The results of this study emphasize the need for training to increase awareness of and knowledge about the symptoms, prevention, and treatment of LAST. The main limitations of the study include the limited number of participants. The study proves that there is an educational gap in the awareness and knowledge of symptomatology, prevention, and treatment of LAST for non-anesthesiologist providers that deliver anesthesia care (Aydin, 2022).

Related Literature

Yakar et al. (2022) conducted a peer-reviewed study to evaluate the knowledge, perception and attitudes about LAST from residents working in intensive care units. A total of 148 residents from Dokuz Eylul University were included in the study. The

residents received a survey with 41 questions about their formal education and knowledge related to LAST. Knowledge questions included symptoms, toxic doses, protocols and treatment. Statistical analysis was performed using SPSS statistical analysis software. Distribution of data was analyzed using the Shapiro-Wilk test. Only 34.% of the residents had received formal education on LAST and only 22.3% felt that their knowledge of LAST was sufficient. 41.2% of the residents reported knowledge about 20% lipid emulsion treatment for LAST, but 88% did not know whether their hospital actually had lipid emulsion. The authors concluded that residents working in intensive care units require formal education on LAST (Yakar et al., 2022).

Critical Summary

Jamaleddin Surani et al. (2022), Aydin (2022), and Yakar et al. (2022) conclude that there is a gap in knowledge regarding LAST symptomatology and treatment amongst multiple types of providers involved in caring for patients at risk of LAST. Properly educated providers are crucial to avoiding fatal complications of LAST. Ferguson et al. (2019) show effectiveness of an educational interval in nursing units and outpatient and perioperative settings. Bevil et al. (2020) used a simulation-based study to assess knowledge and retention regarding LAST, which yielded positive results endorsing professional development education of LAST also. Ferry & Cook (2020) agree with advancing knowledge of LAST through education. Ferry & Cook (2020) utilized a web-based educational self-learning module to do so. The aforementioned studies endorse an educational teaching plan to enhance identification and treatment of LAST. Gaps in literature include identifying the most beneficial method at educating providers, the time

interval at which education sessions need to be administered, and which method can educate the greatest number of providers.

Utilization of the recently completed evidence-based LAST teaching plan will now provide perioperative clinicians with the evidence-based information for early identification and treatment of local anesthetic toxicity reactions, positively impacting patient care.

Theoretical Framework

The first theory that distinguished adult learning (andragogy) from child learning (pedagogy) was the Adult Education Theory by Malcolm Knowles (Caruso et al., 2020). Knowles proposed a list of characteristics specific to adult learners that facilitate a mentoring and collaborative teaching style. The attributes of adult learners are centered around independence of the adult learner, incorporation of experience, integration of learning into daily life, problem-centered approaches, and utilizing internal factors for greater motivation (Knowles, 1984). These attributes separate the adult learner from the child learner and provide a basis for benefits of a personalized learning environment.

Knowles (1984) described self-directed learning as centered around the needs of the student where the student is an active participant (van der Walt, 2019). The teacher in this situation is supportive in serving as a guide for procedure, planning, and finding the best route to success, but the student must climb on their own to succeed and take responsibility for their learning outcomes (van der Walt, 2019). As learners progress, they adapt and develop skills that allow interaction with the learning environment. Once the learner masters the ability to be self-directed, commitment to their learning experience increases and a sense of responsibility for the learning experience ensues (van

der Walt, 2019). Self-directed learners allow for an understanding of the adult learner's perspective and confidence in the learner's experience based on their capabilities and preferences (van der Walt, 2019).

The Adult Education Theory basis (Knowles, 1984) is integral in the evidence-based teaching plan for CRNAs to recognize early signs and symptoms and pursue appropriate treatment of LAST. Instituting a self-learning education module for perioperative providers before attending a simulation experience for direct incorporation of skills and knowledge could address the aspects of independent learning and incorporation of experience as described by Knowles. The LAST teaching plan will focus on proper access and effective implementation of the algorithmic treatment pathway managing local anesthetic overdose.

Independent learning, experience, incorporation into daily life, problem centered approaches, and internal motivation are pillars of the Adult Education Theory (Knowles, 1984) that guide the focus of the evidence-based teaching plan of this project. This teaching plan's ultimate goal is to provide the practitioners with the knowledge and skills to identify LAST and provide effective treatment to ensure positive patient outcomes.

Method

Design

This DNP project is a quality improvement teaching plan for LAST. The importance of the project and the need to improve practice is vital for change to occur (Polit & Beck, 2022). The project directors identified content areas from the literature to be addressed in a teaching plan for LAST. The content areas were rated by experts via

survey. The survey assessed what the experts believe should be included in a teaching plan for LAST. This teaching plan may be used to create a future interventional education plan for disseminating necessary knowledge and skills in providing priority evidence-based care to LAST patients. The teaching plan may be utilized by an expert provider to create an interventional education session. Some examples of expert providers are anesthesiologist, CRNA, or a registered nurse in a setting that would care for a patient at risk for LAST, including but not limited to perioperative nurses, and post anesthesia care unit nurses.

This teaching plan is relevant for any facility caring for patients at risk for LAST. Any provider working in the perioperative setting could potentially be caring for patients at risk of LAST. The operating room, post anesthesia care unit, intensive care unit, and same day surgery may all be units caring for this patient population.

Sample and Setting

Empirical and related literature gathered by the project directors were used to create the teaching plan. This evidence-based data collection creates a cohesive literature review that is the foundation of the teaching plan. The primary setting of this project was the Frank J. Tornetta School of Anesthesia (FJTSA), which is affiliated with Einstein Montgomery Hospital and La Salle University in Philadelphia, Pennsylvania.

A survey was developed identifying and reviewing the content of the teaching plan for review by expert professionals, such as anesthesiologists and CRNAs with a goal of a minimum of 20 participants. With these results, the content of the teaching plan was reviewed and refined. Suggested improvements were made to the teaching plan and any information deemed irrelevant was removed.

The survey was disseminated via electronic communication to experts of Jefferson Abington Health, St. Mary's Medical Center, St. Luke's Bethlehem, Virtua Health, Hospital of the University of Pennsylvania, and Einstein Medical Center Montgomery.

Ethical Considerations

This project was submitted to the Institutional Review Board (IRB) at La Salle University for review. There were no identifiable risks to participants in the educational teaching plan. Any data collected regarding participants will remain anonymous. There was no compensation for participation. Since there were no identifiable risks to the participants in this project, the project was submitted in the exempt category. The exemption or approval from the IRB is included in Appendix C.

Consent from participants was assumed upon completion of the Qualtrics survey. The data collected from participants remained anonymous and only the project directors and DNP committee faculty had access to the data collected. All data will be kept on a password protected computer and will be destroyed following analysis.

Instrumentation

This teaching plan includes educational topics related to LAST that were identified in the literature. The teaching plan was used to create an interventional plan for disseminating necessary knowledge and skills in providing priority evidence-based care to LAST patients. The evidence-based teaching plan includes information and methods for educating perioperative providers to identify and treat patients with LAST.

Evaluation of the teaching plan content was performed using electronic survey tools disseminated to expert providers. This evaluation included appropriate inclusion,

depth, and encompassment within the teaching plan. The results include quantitative and qualitative results for analysis, including content validity, and common themes of suggestions and revisions. The survey provided questions to evaluate the teaching plans with numerical ratings, as well as provider area for short answer text. Topics such as (1) signs and symptoms of LAST, (2) location of emergency lipid emulsion therapy, (3) difference between LAST treatment and ACLS protocol, (4) definition of LAST, (5) when LAST can occur, and the (6) initial treatment of LAST were included. The completed validity forms provided quantitative and qualitative data that was protected and reviewed via Qualtrics software.

Procedures and Data Collection

Data collection was done via literature review to evaluate current evidence related to LAST education to determine important topics to include in the teaching plan. The evidence collected discussed the lack of knowledge related to LAST events and barriers to educating providers involved in local anesthetic practice. The important topics were included then compiled and provided to experts for further analysis.

We developed an eight question Qualtrics survey and distributed it via email to 32 experts at Jefferson Abington Health, St. Mary's Medical Center, St. Luke's Bethlehem, Virtua Health, Hospital of the University of Pennsylvania, and Einstein Medical Center Montgomery. The survey was sent out between March 4th, 2024 and March 12th, 2024. The survey included a statement regarding voluntary participation, assuming informed consent upon completion of the survey. The data collection was completed and the survey was closed by March 19th, 2024. The information remained anonymous and quantitative and qualitative data was reviewed in Qualtrics software.

Data Analysis

Collection of quantitative and qualitative data was done upon receiving survey results from the experts. Quantitative data was based on the number of experts who felt that topics were highly relevant, quite relevant, somewhat relevant, or not relevant. Content Validity Index (CVI) was used to evaluate quantitative data. CVI values ranged from 0 to 1. $I-CVI > 0.78$ determined that a topic was relevant while $I-CVI < 0.78$ determined a topic was irrelevant or requires revision (Yusoff, 2019).

Qualitative data was collected based on common themes found in survey responses from the experts. The DNP chair was consulted regarding qualitative data interpretation and analysis. The DNP project partners and chairs determined whether to accept or not to accept suggestions made by experts in the narrative comments of the survey. This data collection supports the development of the teaching plan.

Discussion

Findings

Quantitative Findings

A total of 26 expert responses were received and utilized for quantitative analysis, including 22 responses from CRNA's and 4 from Anesthesiologists. Experts were asked about their years of experience, with options ranging from less than 5 years to greater than 26 years. Most experts (62%) had less than 5 years of experience, 15% had 6 to 10 year's experience, 12% had 11 to 15 years experience, 8% had 16-20 year's experience, and 4% had greater than 26 years of experience.

There were six topics provided for the experts to review and all six topics were found to be relevant (see Appendix D for Expert Analysis Survey). The three topics scored the highest (I-CVI = 1) were defining LAST, knowing when LAST can occur, and the initial treatment for LAST. The two topics that scored the second highest (I-CVI = 0.92) were signs and symptoms of LAST and how LAST varies from ACLS protocol. The lowest scoring but still relevant topic (I-CVI = 0.84) was location of lipid emulsion therapy. No content areas were deemed to be irrelevant or needing revision or elimination (Table 4 for Content Validity Summary).

Qualitative Findings

Experts were asked at the end of the survey if there were any additional topics that should be included in the proposed educational outline. These qualitative findings were analyzed by the DNP students and chairs. Topics recommended to be included were reviewing the dosages of local anesthetics and the dosages and infusion rates of lipid emulsion therapy. The DNP team determined that the importance of local anesthetic doses could be included in the topic related to when LAST can occur. The DNP team determined that the doses and infusion rates would be included in the topic of initial treatment of LAST. Respondents also suggested incorporating a LAST education session for providers. This is a goal for future DNP projects to implement by using the teaching plan created in this DNP project.

Limitations

One limitation of this project is the lack of diversity between experts utilized for content validity since there were only four anesthesiologists and 22 CRNAs.

Additionally, there was an imbalance in years of clinical experience, where 63% of

respondents reported less than 5 years of experience. The authors of this project also found there to be limited studies that specifically focused on teaching plans specifically related to LAST, which emphasizes the need for more research and literature on this topic.

Implications

Implementation of this evidence-based teaching plan related to LAST will help prepare providers for LAST emergencies in the perioperative setting. Relevant topics to be included in the teaching plan for LAST were supported by experts via content analysis. The evidence-based literature review reveals a gap in knowledge and supports the development of a teaching plan for perioperative providers exposed to LAST.

Future Projects, Plans and Dissemination

The findings of this project and the evidence-based teaching plan will be disseminated to future DNP cohorts at Frank J. Tornetta School of Anesthesia at Einstein Medical Centre Montgomery/ La Salle University School of Nursing and Health Sciences. The project will also be disseminated via the La Salle University Digital Commons. The goal of this current scholarly endeavor is for future DNP cohorts to utilize this project to create and implement the teaching plan as an educational intervention in the clinical setting. This multi-phase approach to the DNP project allows for collaboration between DNP cohorts as well as continued literature review. This approach also allows time to review current LAST protocols and procedures and to involve hospital administrators and medical directors to insure effective change and promote project stability.

Conclusion

There is a significant knowledge gap related to the recognition, response, and treatment of LAST as evidenced by the literature (Ferguson et al., 2019). Perioperative providers exposed to local anesthetics in their practice need continued education on the pathophysiology, signs and symptoms, and proper implementation of LAST protocols in order to safely and effectively respond to LAST emergencies. The purpose of this DNP project was to develop an evidence-based teaching plan regarding LAST that is based on current literature and supported by expert reviewers.

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Table 1

Search Process Review of Literature

N=1,129					
Database	Total Articles	Articles Remaining After Title Review	Articles Remaining After Abstract Review	Articles Retrieved and Examined	Articles that fit Inclusion Criteria
Cochrane Library	15	0	0	0	0
CINAHL	422	12	8	3	1
La Salle University's Summon	282	16	4	4	3
Medline	184	5	2	0	0
PubMed	63	2	1	1	1
ProQuest Dissertations & Theses Global	163	8	3	3	0

Note. Number of duplicate articles removed

Table 2

Review of Literature Matrix

Database # Article First Author, Year (full citation in References)	Purpose of Study Major Variables (IV, DV) or Phenomenon	Theory or Conce ptual Frame work	Design	Measure ment Major Variables (Instrume nt)	Data Analysis (Name of Statistics, descriptive, Inferential and Results)	Findings	Evidence Level of Research & Quality Johns Hopkins Nursing Evidence-Based Practice
CINAHL #1 Ferguson et al. (2019)	To improve knowledge and raise awareness of RNs assisting CRNAs and Anesthesiologi sts with peripheral nerve block or spinal procedures about LAST	None	Evidence - based practice project design based on a modified Iowa model.	A 10 question pre-test was given, followed by a 30 minute training session and post- test.	70 RNs in a 292-bed community hospital in perianesthesia and perioperative settings were included. A nonparametric two- sample t test (Wilcoxon exact test) was used. ($\alpha = 0.05$)	The median comfort level on the post- education test was 80% and the median post- education score was 100% (p <0.0001).	Level III-B

Summons #1 Bevil et al. (2020)	To evaluate knowledge retention regarding LAST in perianesthetic nursing staff IV = high-fidelity simulation and short didactic session	None	Single-center randomized pre/post test design	20 question multiple-choice test immediately after simulation exercise, 1 month later and 3 months later	Logistic mixed-effects regression was used to model test performance as a function of assessment time using four-level factors (pre-simulation, post-lecture, 1 month post-training and 3 months post-training).	14 nurses participated in the study, data from 12 participants was analyzed. Average pretest score was 52% (95% CI = 0.45-0.58). Average post-test score was 90% (p < 0.0001 compared to pretest), average 1 month score was 81%, average 3 month score was 77%.	Level V-B
Summons #2 Ferry & Cook (2020)	To implement and evaluate an educational program based on the identification and management of LAST IV = interactive	Knowl es Adult Learn ing Theory	Learning needs assessment before and after educational module	An interactive web-based educational self-learning module consisting of four modules	Formal and informal qualitative learning needs assessment using convenience sampling was distributed. The pre-education survey was repeated immediately after completion of the module and again 6 months later.	2,185 nurses were sent the Learning-Needs Assessment (LNA) formal survey. Pre-education scores in knowledge, signs & symptoms, and treatment were	Level V-B

	web-based educational self-learning module			identifying signs, symptoms, and treatment of LAST.		29%, 38% and 24% respectively. Post-education scores were 87%, 76% and 75% respectively.	
Summons #3 Aydin, P. (2022)	Measure levels of knowledge about systemic toxicity of local anesthetics.	None	Multi-center data collection	Questionnaire study	200 participants, 4 did not fully complete the questionnaire, so their data were excluded. Categorical variables relationships were tested using chi-square analysis	82.1% of providers did not know or did not remember lethal complications of local anesthetic drugs Knowledge of LAST algorithms: 14.3% states exist, 41.3% answered "no," and 44.4% did not know	Level III-B
Pubmed #1 Jamaluddin	To investigate the awareness of LAST and knowledge on local anesthetics in	None	Prospective interventional study.	Pretest questionnaire, a medical educational session on LAST,	Data from this study was analyzed using SPSS version 25.0. A one-way ANOVA was used to determine differences between mean scores. If a significant p value from one-way ANOVA was found, a pairwise	Data from 134 postgraduate trainees was analyzed. An increase from pretest to post-test (16.4% to	Level III-A

Surani et al. (2022)	postgraduate trainees.			and post-test questionnaire.	comparison by Post Hoc test was conducted. Independent t-test was used to determine differences in mean scores between two groups. McNemar test was used when comparing dichotomous dependent variables. Qualitative data analysis was conducted using a chi-squared or Fisher exact test. All comparisons with value < 0.05 were considered to have significant differences in mean scoring.	97.8%) was seen (p<0.0001). Average total improvement at post educational scores on awareness was 3.93 (95% CI 3.47-4.40).	
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Note. *Full citation cited in references

Table 3

Project Planning Matrix

Objectives	Methods and Techniques	Timeline	Evaluation Methods	Responsible Personnel	Outcomes
Short Term Objectives					
1. Literature review	Database search	Fall 2022 - Spring 2022	Evaluation with full project team	Future DNP cohort project team	Complete literature review with matrix
2. Appraisal of the evidence	Appraisal tool	Fall 2022 - Spring 2024	Team review utilizing Johns	Project team	Literature appraised
Intermediate Term Objectives					
1. Develop teaching plan	Content/presentation plan development	Summer 2023 - Spring 2024	Consult with program development experts	Project team	Completion of teaching curriculum
2. Validation through expert review	Identify experts	Fall 2023 - Spring 2024	Collect and analyze qualitative data	Project team, clinicians, and educators	Establish content validity of teaching plan

Objectives	Methods and Techniques	Timeline	Evaluation Methods	Responsible Personnel	Outcomes
Long Term Objectives					
1. Prepare teaching program for future implementation	Present teaching plan	TBD; Goal 2024-2025	Pre-post test	Future DNP cohort project team	Provide evidence-based teaching plan to identified clinicians and educators
2. Increase awareness and education	Present teaching plan	TBD; Goal 2024-2025	Pre-post surveys	Future DNP cohort project team	Increase clinician and educator knowledge

Table 4

Content Validity Summary

Topic	CVI
1. Signs and symptoms of LAST	0.92
2. Location of emergency lipid emulsion therapy	0.84
3. How LAST treatment varies from ACLS protocol	0.92
4. Definition of LAST	1
5. When LAST can occur	1
6. Initial treatment of LAST	1

APPENDIX A

Letter of Support of Project



More than Medicine

Frank J. Tornetta School of Anesthesia
LaSalle University School of Nursing

Michael Kost, DNP, CRNA
Director

Cynthia Betron, DNP, CRNA
Associate Director

September 28, 2022

DNP Committee Members
(Gillespie & Snavely)

Letter of Support for DNP Project

Dear LaSalle University Nurse Anesthesia Track DNP Project Committee Members:

This letter is in strong support of the DNP project currently proposed by Katie Gillespie and Kathleen Snavely. The Frank J. Tornetta School of Anesthesia at Einstein Medical Center Montgomery will provide clinical experts for Ms. Gillespie's and Ms. Snavely's project, while adjusting their anesthesia clinical and class schedules to allow for adequate time to complete their DNP project. Once the team successfully defends their proposal, they will submit the project to Einstein's Institutional Review Board (IRB) for review. Since the nature of the project is quality improvement and is without risk to human subjects, it is expected to be given IRB approval with exempt status. Any future work that involves use of this project's materials will be submitted for its own separate IRB review.

Please let me know if you have any questions or need any additional information. We remain in full support of Ms. Gillespie's and Ms. Snavely's DNP project and will make every effort to accommodate them so that their DNP project remains a scholarly priority while enrolled in this program.

Respectfully Submitted,

A handwritten signature in black ink that reads 'Michael Kost'.

Michael Kost, DNP, CRNA, CHSE, FAAN, FAANA
Program Director

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Einstein Medical Center Philadelphia

Einstein Medical Center Elkins Park

Einstein Medical Center Montgomery

MossRehab

Willowcrest

Einstein Physicians

Einstein Outpatient Care

APPENDIX B

Teaching Plan

Title: Evidence-Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic Toxicity) Response Protocol

Purpose: The purpose of this teaching plan is to educate perioperative providers on how to identify and respond to LAST.

Goal: This evidence-based education is for increasing knowledge of pathophysiology, identifying varying signs and symptoms of local anesthetic toxicity, and implementing timely treatment.

Behavioral Objectives	Outline	Method of Instruction	Time Allotted	Method of Evaluation
<p>Defining local anesthetic systemic toxicity</p>	<p>Local anesthetics provide analgesia at target tissues or sites by</p> <ul style="list-style-type: none"> ● reversibly binding to voltage-gated sodium channels ● inhibiting sodium conductance ● preventing neuronal depolarization (Tkach et al., 2023) <p>LAST is a result of the local anesthetic entering the systemic circulation causing excessively high plasma levels. This may occur through</p> <ul style="list-style-type: none"> ● Intravascular injection ● Accumulation of active local anesthetic metabolites ● Absorption of local anesthetic from tissues ● Presence of patient comorbidities <p>Local anesthetic systemic toxicity (LAST) is an adverse outcome that may occur after a patient receives local anesthetic drugs. The effects may include</p> <ul style="list-style-type: none"> ● central nervous system ● cardiovascular toxicity <p>Last incidence is difficult due to underreporting and unrecognized toxicity.</p> <ul style="list-style-type: none"> ● No national database for reporting ● No mandated reporting 	<p>Lecture/ Discussion</p>	<p>10 minutes</p>	<p>Q&A, post-test</p>

	(El-Boghadly et al., 2018) (Tkach et al., 2023)			
When LAST may occur	<p>LAST can occur anywhere local anesthetics may be administered</p> <ul style="list-style-type: none"> ● Hospital setting <ul style="list-style-type: none"> ○ Operating room ○ Interventional radiology ○ Cardiac catheterization lab ○ Electrophysiology lab ○ Emergency room ○ Procedural rooms ○ Pre-operative areas <ul style="list-style-type: none"> ■ Same day surgery ○ Intensive care Units ● Outpatient centers <ul style="list-style-type: none"> ○ Urgent care ○ Pain Centers ○ Surgery Centers ● Offices <ul style="list-style-type: none"> ○ Dental ○ Dermatology ○ Orthopedic ○ Many more <p>Up to 20% of LAST occurrences are in non-hospital settings.</p> <p>Vigilance during and after all local anesthetic use</p> <ul style="list-style-type: none"> ● ASA monitors <ul style="list-style-type: none"> ○ Pulse oximetry ○ ECG ○ Blood pressure <p>Factors that predispose a patient to LAST are</p> <ul style="list-style-type: none"> ● hypoxia ● acidosis <p>Comorbidities that increase the risk of LAST</p> <ul style="list-style-type: none"> ● heart disease ● reduced ejection fraction ● conduction abnormalities ● mitochondrial dysfunction ● liver disease ● kidney disease ● Patient characteristics 	Lecture/ Discussion	10 minutes	Q&A, post-test

- Advanced age (>60 years)
- Young age (<16 years)
- Low muscle mass
 - Neonates
 - Infants
 - Debilitated elderly
- Female >male
- Medications that inhibit sodium channels

Can reduce risk by

- Decreasing dose of local anesthetic
- Using a test dose
 - Example: 5 mcg/mL of epinephrine
 - Know expected response onset, duration, and limitations of test dose in identifying intravascular injection
- Incremental dosing
 - Observing for signs and querying frequently for symptoms in between doses
- Periodic aspiration prior to injection and at increments while observing for blood

Local Anesthetic Agent Dosing

AGENT	MAXIMUM DOSAGE
Esters	
Procaine (Novocaine)	7 mg/kg Max dose 350-600 mg
Chlorprocaine (Nesacaine)	Without epi: 11 mg/kg; max 800 mg total dose With epi: 14 mg/kg; max 1000 mg
Amides	
Lidocaine (Xylocaine)	Without epi 4.5 mg/kg; max 300 mg

	<table border="1"> <tr> <td data-bbox="397 205 620 310">Lidocaine with epi</td> <td data-bbox="620 205 1003 310">With epi 7 mg/kg</td> </tr> <tr> <td data-bbox="397 310 620 447">Mepivacaine (Polocaine, Carbocaine)</td> <td data-bbox="620 310 1003 447">7 mg/kg; max 400 mg</td> </tr> <tr> <td data-bbox="397 447 620 552">Bupivacaine (Marcaine)</td> <td data-bbox="620 447 1003 552">Without epi: 2.0 mg/kg; max 175 mg</td> </tr> <tr> <td data-bbox="397 552 620 657">Bupivacaine with epi</td> <td data-bbox="620 552 1003 657">With epi 3 mg/kg; max 225 mg</td> </tr> <tr> <td data-bbox="397 657 620 762">Prilocaine (Citanest)</td> <td data-bbox="620 657 1003 762">Body weight <70 kg: 6 mg/kg; max 500 mg</td> </tr> <tr> <td data-bbox="397 762 620 898">Ropivacaine</td> <td data-bbox="620 762 1003 898">3 mg; max 200 mg for minor nerve block with or without epi</td> </tr> </table> <p data-bbox="397 972 950 1003">(Weinberg et al., 2020) (Elisha et al., 2023)</p>	Lidocaine with epi	With epi 7 mg/kg	Mepivacaine (Polocaine, Carbocaine)	7 mg/kg; max 400 mg	Bupivacaine (Marcaine)	Without epi: 2.0 mg/kg; max 175 mg	Bupivacaine with epi	With epi 3 mg/kg; max 225 mg	Prilocaine (Citanest)	Body weight <70 kg: 6 mg/kg; max 500 mg	Ropivacaine	3 mg; max 200 mg for minor nerve block with or without epi			
Lidocaine with epi	With epi 7 mg/kg															
Mepivacaine (Polocaine, Carbocaine)	7 mg/kg; max 400 mg															
Bupivacaine (Marcaine)	Without epi: 2.0 mg/kg; max 175 mg															
Bupivacaine with epi	With epi 3 mg/kg; max 225 mg															
Prilocaine (Citanest)	Body weight <70 kg: 6 mg/kg; max 500 mg															
Ropivacaine	3 mg; max 200 mg for minor nerve block with or without epi															
Signs and Symptoms of LAST	<p data-bbox="397 1039 954 1108">A patient exhibiting LAST can present with any combination of neurologic symptoms:</p> <ul style="list-style-type: none"> <li data-bbox="446 1113 808 1144">● Seizures (most common) <li data-bbox="446 1150 906 1507">● Altered mental status <ul style="list-style-type: none"> <li data-bbox="544 1186 906 1329">○ Excitation <ul style="list-style-type: none"> <li data-bbox="641 1224 803 1255">■ Agitation <li data-bbox="641 1262 816 1293">■ Confusion <li data-bbox="641 1299 906 1329">■ Muscle twitching <li data-bbox="544 1335 841 1507">○ Depression <ul style="list-style-type: none"> <li data-bbox="641 1373 829 1404">■ Drowsiness <li data-bbox="641 1411 841 1442">■ Obtundation <li data-bbox="641 1449 764 1480">■ Apnea <li data-bbox="641 1486 751 1518">■ coma <li data-bbox="446 1518 597 1549">● Tinnitus <li data-bbox="446 1556 602 1587">● Diplopia <li data-bbox="446 1593 662 1625">● Metallic taste <li data-bbox="446 1631 727 1663">● Perioral numbness <li data-bbox="446 1669 893 1875">● Cardiac symptoms: <ul style="list-style-type: none"> <li data-bbox="544 1707 893 1738">○ Cardiovascular collapse <li data-bbox="544 1745 748 1776">○ Hypotension <li data-bbox="544 1782 737 1875">○ Arrhythmia <ul style="list-style-type: none"> <li data-bbox="641 1808 773 1839">■ Ectopy <li data-bbox="641 1845 906 1875">■ Conduction block 	Lecture/ Discussion	10 minutes	Q&A, post-test												

	<ul style="list-style-type: none"> ■ Asystole ■ Bradycardia ■ ventricular fibrillation ■ ventricular tachycardia ■ Torsades de pointes <p>Providers should have a low threshold for consideration of LAST due to</p> <ul style="list-style-type: none"> ● vast variability in LAST signs and symptoms ● timing of onset ● association with differing diseases <p>(Goldhaber-Fiebert et al., 2021) (Elisha et al., 2023)</p>			
Initial treatment of LAST	<p>Focus on preventing hypoxia and acidosis, which are known to potentiate LAST.</p> <p>Early recognition and treatment of LAST has been shown to greatly reduce mortality.</p> <ul style="list-style-type: none"> ● Utilize cognitive aids <ul style="list-style-type: none"> ○ Posters ○ Checklists ○ Emergency manuals ○ Phone apps <p>Cognitive aids provide an organized model that guide practitioners towards appropriate life-saving actions. This makes it easier to recall information and organize thoughts to directly solve the problem and prevent mistakes (Swerdlow & Osborne-Smith, 2023).</p> <ul style="list-style-type: none"> ● Stanford Cognitive Aid Review <ul style="list-style-type: none"> ○ Crisis Resources: <ul style="list-style-type: none"> ■ Inform team ■ Call for help ■ Call for lipid emulsion (20% Intralipid STAT) ○ Stop Triggers: <ul style="list-style-type: none"> ■ Stop any local anesthetic injection or infusion. ○ CPR: <ul style="list-style-type: none"> ■ If pulseless, start CPR, 100% O2 @ 10-15L/min, start lipid 	Lecture/ Discussion	10 minutes	Q&A, post-test, return demonstrati on, demonstrati on of appropriate use of cognitive aid provided.

	<p>emulsion, then intubate if indicated.</p> <ul style="list-style-type: none"> ○ Lipid emulsion: <ul style="list-style-type: none"> ■ Bolus lipid emulsion 20% 100 mL IV over 2-3 min (if < 70 kg: give 1.5mL/kg IV bolus) ■ Infuse lipid emulsion 20% 250mL IV over 15-20 min (if < 70 kg: infuse 0.25 mL/kg/min for 20 min) ■ If unstable: repeat bolus and double the infusion until stable <p>If resuscitation attempts of modified ACLS and lipid emulsion therapy are unsuccessful, prepare for extracorporeal membrane oxygenation (ECMO) cannulation and support.</p> <p>(Goldhaber-Fiebert et al., 2021)</p>			
<p>How LAST treatment varies from ACLS</p>	<p>Variations from ACLS treatment include dosages and drug selection such as:</p> <ul style="list-style-type: none"> ● Epinephrine <ul style="list-style-type: none"> ○ Treat hypotension with low dose epinephrine: <ul style="list-style-type: none"> ○ start with 0.2 - 1 mcg/kg IV ○ Low doses of epinephrine have been shown to result in higher rates of sustained return of spontaneous circulation as compared to high dose epinephrine. ○ Doses of >10 mcg/kg displayed increased rates of acidosis, elevated lactate, ventricular ectopy, hypoxemia, and alveolar damage. <ul style="list-style-type: none"> ■ Can hinder resuscitation from LAST ■ Can decrease effectiveness of lipid emulsion ● Avoid vasopressin 	<p>Lecture/ Discussion</p>	<p>5 minutes</p>	<p>Q&A, return demonstration of evidence-based AHA protocols.</p>

	<ul style="list-style-type: none"> ○ Administration during LAST has been shown to cause <ul style="list-style-type: none"> ■ Elevated lactate ■ Bradycardia ■ Hypotension ● Arrhythmia treatment <ul style="list-style-type: none"> ○ Amiodarone is the agent of choice ○ Avoid lidocaine and procainamide ● Other medications to avoid <ul style="list-style-type: none"> ○ Calcium channel blockers - enhance local anesthetic-induced cardiac disturbances ○ Beta blockers - enhance local anesthetic-induced cardiac disturbances <p>Without seizure suppression, the patient may develop CNS depression, requiring airway securement to prevent and treat hypoxia, acidosis, and hypercapnia.</p> <ul style="list-style-type: none"> ● Benzodiazepines (first line) ● If benzodiazepines are not immediately available, low dose propofol <ul style="list-style-type: none"> ○ Propofol is not ideal due to the probability of contributing to further hemodynamic instability in a patient already experiencing cardiovascular collapse. ○ Propofol does not contain enough lipid content <ul style="list-style-type: none"> ■ Not to be used as a substitute for lipid emulsion therapy. <p>(Goldhaber-Fiebert et al., 2021) (Tkach et al., 2023)</p>			
<p>Location of emergency lipid emulsion therapy in your place of work</p>	<p>Be prepared with a plan for managing LAST!</p> <p>Location of lipid emulsion will be specific to each institution.</p> <ul style="list-style-type: none"> ● Should be within close proximity to areas of administering local anesthetics or caring for patients that have received 	<p>Lecture/ Discussion</p>	<p>5 minutes</p>	<p>Q&A</p>

	<p>local anesthetics, such as</p> <ul style="list-style-type: none"> ○ Operating room ○ Interventional radiology ○ Cardiac catheterization lab ○ Electrophysiology lab ○ Procedural rooms ○ Labor and Delivery ○ Post-anesthesia care unit ○ Intensive care unit <p>Lipid emulsion therapy can yield quick cardiovascular stability and perfusion. Lipid emulsion therapy targets LAST through</p> <ul style="list-style-type: none"> ● Redistribution of local anesthetic from the brain to skeletal muscle and liver for clearance <ul style="list-style-type: none"> ○ Decreased plasma concentration of local anesthetic ● Direct inotropic effect on the heart <ul style="list-style-type: none"> ○ Increased calcium influx ○ Increased intracellular calcium concentration ● Reduction of reperfusion injury ● Metabolic effect - supply of free fatty acids available for utilization for myocardial tissue <p>Patients should be monitored closely after resuscitation.</p> <ul style="list-style-type: none"> ● If duration of local anesthetic action is longer than duration of lipid emulsion, there is a chance of reoccurrence of hemodynamic instability ● Patients should be monitored for a minimum of 4-6 hours. ● If symptoms are limited to CNS, monitor for at least 2 hours. <p>(Elisha et al., 2023) (Tkach et al., 2023)</p>			
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APPENDIX C

IRB Letter of Approval

Date: December 7th, 2023

Type of Review: Initial

Project Title: Evidence-Based Teaching Plan on Implementing LAST (Local Anesthetic Systemic Toxicity) Response Protocol

Investigator: Kathleen Snavely & Katie Gillespie

To the investigator:

The abstract of the planned activity noted above was reviewed by a member of the La Salle University IRB and determined not to be human subjects research. This decision applies only to the planned activity described in the abstract as provided to the IRB. As the person accountable for the conduct of the activity, you are responsible for ensuring that it is conducted as described in the materials provided.

Please note that any data collected for this activity cannot be analyzed and presented for another purpose unless an updated project description and analysis plan is approved by the IRB. Although much can be learned from these types of activities and sharing your findings is strongly encouraged, this project as currently described cannot be referred to as “human subject research” when discussed in publications and presentations. Innovation Programs (IP) and Quality Improvement (QI) projects should not be described as a “study” or “research” in publications or presentations, but should be clearly identified as a “program”, “program evaluation”, or “QI project.” An acceptable statement that could be included in the manuscript would be “The project was reviewed and determined not to meet the definition of human subjects research by the La Salle University IRB.”

Please contact me at borkowsk@lasalle.edu if you have any questions.

Susan C. Borkowski, Ph.D.

Chair, Institutional Review Board

APPENDIX D

Expert Analysis Survey

Expert Content Validity Analysis				
Topic	Please rate the relevance of the topics below.			
1. Signs and symptoms of LAST	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant
2. Location of emergency lipid emulsion therapy	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant
3. How LAST treatment varies from ACLS protocol	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant
4. Definition of LAST	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant
5. When LAST can occur	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant
6. Initial treatment of LAST	1= Not relevant	2= Somewhat Relevant	3 = Quite Relevant	4 = Highly Relevant