A Quality Improvement Initiative: A Provider Education Simulation For Management And Treatment Of Local Anesthetic Systemic Toxicity Protocol

by

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Abstract

Local Anesthetic Systemic Toxicity (LAST) is a rare, life-threatening complication of regional anesthesia that can cause severe neurological and cardiovascular collapse. Due to its low clinical incidence, a significant practice gap exists; perioperative providers frequently lack the knowledge and confidence to recognize and treat it efficiently. This quality improvement project evaluated whether a high-fidelity educational video simulation, paired with evidence-based cognitive aids, improves perioperative staff knowledge and confidence compared to traditional educational protocols. Guided by the Johns Hopkins Nursing Evidence-Based Practice Model and a Plan-Do-Study-Act framework, a quantitative, quasi-experimental pre-test/post-test design was implemented at Corewell Health Beaumont Grosse Pointe Hospital. Perioperative nursing staff completed identical baseline and post-intervention assessments evaluating objective clinical knowledge (12-item quiz) and self-reported confidence (13-item, 5-point Likert scale). Participants viewed a targeted LAST video simulation filmed at the Eugene Applebaum Simulation Center that incorporated the American Society of Regional Anesthesia and Pain Medicine (ASRA) checklist. Data from the independent cohorts (n=24 pre-intervention; n=16 post-intervention) were analyzed using independent samples t-tests.The intervention yielded a statistically significant improvement in objective knowledge scores ($p \leq 0.05$), with the mean score rising from 8.5 (SD = 1.14) pre-intervention to 10.6 (SD = 1.20) post-intervention, demonstrating a large effect size (Cohen's d = 1.8). Self-reported clinical confidence also significantly elevated ($p \leq 0.05$), nearly doubling from a pre-intervention mean of 27.4 (SD = 3.90) to a post-intervention mean of 47.6 (SD = 2.45). Integrating immersive video simulations with standardized cognitive aids effectively translates complex crisis protocols into retainable knowledge while mitigating clinical hesitation in high-acuity emergencies. Despite limitations like sample size attrition and a single-center design, this project establishes a scalable, low-cost blueprint for high-risk, low-frequency event readiness. Incorporating this simulation tool into onboarding curriculum and annual competencies is recommended to sustain emergency preparedness and maximize patient safety

Keywords: local anesthetic systemic toxicity (LAST), simulation-based education, perioperative nursing, ASRA checklist, educational video simulation

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A Quality Improvement Initiative: A Provider Education Simulation For Management And Treatment Of Local Anesthetic Systemic Toxicity Protocol

Local Anesthetic Systemic Toxicity (LAST) is a rare but potentially life-threatening complication arising from the administration of local anesthetics, primarily encountered during procedures requiring regional anesthesia (Ackerman et al., 2023; Ferry & Cook, 2020). The increasing preference for regional anesthesia in clinical practice, which is motivated by a drive to decrease opioid use and associated complications postoperatively, has increased the importance of understanding and effectively managing LAST (White et al., 2024). Although uncommon, LAST can lead to significant outcomes affecting both the cardiovascular and central nervous system. This poses severe risks to a patient's well being if not immediately recognized and treated adequately (Ferry & Cook, 2020; White et al., 2024).

This issue warrants attention because failure to quickly recognize and manage LAST can result in significant injury, fatal outcomes, and increased healthcare costs associated with adverse patient events (White et al., 2024). Additionally, the infrequent occurrence of LAST in the healthcare setting causes perioperative healthcare providers to feel inadequately prepared, reducing their confidence and effectiveness in diagnosing, managing and treating this critical event (Ackerman et al., 2023; Bevil et al., 2020).

Current evidence indicates that perioperative clinicians often possess inadequate knowledge and confidence in handling LAST events. This deficiency can be attributed to the infrequent occurrence of such events and the unfamiliarity of the management in protocols and medications involved (Ackerman et al., 2023; Bevil et al., 2020). Educational interventions, including simulation based training and organized cognitive aids such as the American Society of Regional Anesthesia and Pain Medicine (ASRA) checklist, have demonstrated potential in

enhancing clinician readiness, effectiveness and compliance with established protocols during infrequent yet crucial emergencies (Bevil et al., 2020; White et al., 2024).

Despite progress, there are still significant gaps in our understanding of the most effective educational strategies for improving clinician knowledge and confidence specifically related to LAST management (Lei et al., 2022; Shin et al., 2015). It is essential to assess advanced and targeted educational interventions that can close the gap in knowledge related to LAST and ultimately improve providers readiness for LAST events (Erlinger et al., 2023; Paige et al., 2015).

Therefore, this quality improvement project evaluated the effectiveness of an educational video simulation focused on LAST recognition and management. A pre- and post-intervention questionnaire measured perioperative healthcare provider knowledge and confidence levels. An educational quick reference guide complemented the video simulation, acting as a continuous clinical resource. The primary objective of this project is to establish a strong, evidence-based educational approach that enhances providers competency and confidence, thereby promoting improved patient outcomes and safety during perioperative care.

Background and Significance

A common goal amongst healthcare providers is to seek interventions that enhance patient safety and improve clinical outcomes. LAST, although rare, is a potentially fatal complication that can occur perioperatively after regional anesthesia administration, with risk persisting for up to twelve hours. LAST symptoms advance progressively and may include severe neurological and cardiac manifestations such as seizures, arrhythmias, and cardiovascular collapse if not promptly recognized and treated (Brodt, 2024). Despite the infrequency of LAST, the consequences of delayed recognition and management can significantly compromise patient

safety, potentially leading to death. Given the low incidence but high severity of LAST, there remains a notable practice gap between the potential for occurrence and provider preparedness, highlighting a critical area for educational intervention (Bevil et al., 2020).

Local anesthetic systemic toxicity gained recognition in the early 2000s as potent local anesthetics became more prevalent in perioperative and pain management settings. Over recent decades, evidence has shown that although LAST is uncommon, delayed recognition can quickly escalate to life-threatening events, underscoring the need for standardized management protocols (Neal et al., 2018). Recent research further emphasizes the importance of ongoing provider education, as symptoms of LAST can arise suddenly and progress rapidly (Ackerman et al., 2023). Providers frequently employ nerve blocks and infiltration techniques perioperatively to enhance patient comfort and reduce opioid usage. The use of these techniques inherently increases the potential risk for LAST if the local anesthetics inadvertently enter systemic circulation (Ackerman et al., 2023).

Current educational protocols within hospitals often utilize passive learning methods such as readings, PowerPoint presentations, or online modules. These traditional methods, however, may not sufficiently prepare perioperative providers with the necessary confidence or practical skills to manage LAST events effectively. Simulation-based learning has proven effective in enhancing knowledge retention, improving decision-making skills, and boosting confidence, particularly in managing low-frequency, high-risk clinical scenarios. Kim and Jang (2017) demonstrated that simulation-based training significantly improved outcomes across four domains: knowledge, clinical performance, team competence, and learner satisfaction. Video simulations offer an interactive, realistic experience compared to traditional methods, effectively bridging the gap between theoretical knowledge and practical application by immersing

providers in simulated crisis environments (Cropsey, 2015).

Each incidence of LAST can impose significant financial burdens on healthcare facilities, ranging from tens to hundreds of thousands of dollars due to ICU stays, advanced interventions, and malpractice claims (Neal et al., 2018). Approximately 13.1 million inpatient surgical procedures are performed annually in U.S. acute care hospitals (Agency for Healthcare Research and Quality [AHRQ], 2024). To manage postoperative pain and reduce reliance on systemic opioids, regional and local anesthetic techniques have become a cornerstone of multimodal analgesia. While broad utilization across all surgical specialties is estimated between 10% and 30%, these techniques are highly prevalent in specialized populations; for instance, regional anesthesia is now utilized in approximately 77% of total joint replacements to improve recovery outcomes (American Academy of Orthopaedic Surgeons [AAOS], 2025; Yang et al., 2025). Given LAST's reported incidence of approximately 0.03% (Elisha et al., 2023), around 9,420 LAST events may occur nationally each year. Although direct medication costs, including lipid emulsions, are relatively minor, ICU care alone can exceed $11,000 daily (Dasta et al., 2005; Drugs, 2025). Therefore, investing in targeted, simulation-based educational interventions could significantly reduce anesthesia-related complications, offering considerable financial and clinical benefits by improving patient safety and healthcare sustainability.

The primary aim of this project was to assess provider knowledge and confidence prior to and after viewing an educational video simulation focused on LAST recognition and management.. To guide this research, the following PICO question was formulated: In perioperative healthcare providers (P), does an educational video simulation on LAST (I), compared to current educational protocols (C), improve knowledge and confidence in managing a LAST crisis (O)?

Literature Review

Purpose of Literature Review

The purpose of this literature review was to examine the effectiveness of educational video simulations compared to traditional learning methods in enhancing knowledge retention, clinical preparedness, and confidence among perioperative healthcare providers in recognizing and managing LAST. This review aims to identify gaps in current educational protocols, highlight the strengths of simulation-based interventions, and provide evidence to support integrating video simulation into standard training practices to improve patient safety outcomes and clinical competence.

Definitions of Variables and Concepts

Local Anesthetic Systemic Toxicity (LAST): LAST is a rare but potentially fatal complication resulting from systemic absorption of local anesthetics, leading to severe neurological followed by progressive cardiovascular collapse. Initially, LAST manifests with central nervous system (CNS) excitation symptoms such as dizziness, tinnitus, circumoral numbness, blurred vision, and involuntary muscle twitching due to suppression of inhibitory pathways, potentially progressing to seizures (Neal et. al, 2018). With increasing plasma concentrations, CNS excitation can then lead to CNS depression, causing reduced consciousness leading to potential coma. Progressively, cardiovascular toxicity typically begins with hypertension and tachycardia, followed by ventricular arrhythmias, decreased inotropy, conduction delays, eventually leading to complete cardiovascular collapse at higher local anesthetic plasma concentrations (Neal et. al, 2018).

The treatment of LAST begins with recognition, which involves the immediate identification of clinical signs and symptoms indicative of LAST, which include the neurological

and cardiovascular manifestations previously mentioned. Supportive care is then provided through the establishment of airway, breathing, and circulation, administration of supplemental oxygen, and obtaining intravenous access if not previously established. Symptomatic management follows, including the administration of anti-seizure medications, management of arrhythmias, and supportive cardiovascular interventions. Lipid emulsion therapy is then immediately initiated, according to ASRA guidelines, to facilitate rapid isolation and elimination of the toxic anesthetic agent. Finally, continuous cardiovascular monitoring is implemented to manage potential complications and monitor for hemodynamic stability until the patient becomes symptom free.

Improved technology and understanding of local anesthetics have increased preventive measures associated with LAST. Techniques such as ultrasound guided regional anesthesia, aspiration for blood prior to injection of local anesthetics, as well as the adherence to the specific maximum allowable local anesthetic doses have significantly reduced the incidence of LAST. The use of ultrasound guided techniques, which utilizes direct visualization of structures such as target nerves, surrounding vasculature, needle placement, and local anesthetic injected during regional anesthesia, reduces unintentional injection of local anesthetic into vasculature. Also, standard practice recommends repeated aspiration throughout the administration of local anesthetics, irrespective of anatomical location, as an additional precaution against intravascular injection. Additionally, hospitals and clinical institutions now commonly enforce weight specific maximum local anesthetic dosing guidelines, safeguarding patients against the potential for intravascular injection.

Simulation Based Education: Simulation based education (SBE) is an educational method where providers engage in interactive clinical based scenarios that replicate real life

healthcare experiences. For the purposes of this project, simulation-based education is defined as structured training involving a presentation that demonstrates a mock clinical scenario in a simulation lab, depicting a patient experiencing LAST while illustrating the step-by-step management and treatment protocols. This simulation presentation is designed to enhance clinical knowledge, decision making, and clinical skills in crisis management scenarios, specifically relating to LAST management. This approach is noted for its effectiveness in bridging the gap between theoretical knowledge and practical clinical application, thus improving retention of knowledge and clinical confidence (Bevil et al., 2020).

ASRA Checklist: The American Society of Regional Anesthesia and Pain Medicine (ASRA) checklist is a standardized clinical tool developed to increase patient safety during the management of LAST. In this project, the ASRA checklist refers specifically to a structured, evidence based cognitive aid that outlines critical steps for recognizing, treating, and managing LAST. This checklist includes identification of key signs and symptoms, emergency response protocols, appropriate dosing of lipid emulsion therapy, and crisis management steps that providers must follow during LAST events. This standardized approach aims to improve provider responsiveness, decrease variability in treatment, and enhance clinical outcomes during anesthetic crises.

Knowledge Retention: Knowledge retention refers to the ability of healthcare providers to retain, recall, and apply learned academic and clinical information over time. In this project, knowledge retention specifically addresses the ability of perioperative healthcare providers to accurately recognize the signs, symptoms, and appropriate management of LAST crises at various intervals following simulation based educational interventions. Knowledge retention will be measured using pre- and post- educational intervention assessments. Enhanced retention of

knowledge is associated with improved clinical judgment, reduced hesitation, and more effective crisis management (Ferry & Cook, 2020).

Clinical Confidence: Clinical confidence refers to the healthcare providers trust in themselves to effectively manage clinical scenarios. In this project, clinical confidence specifically refers to perioperative providers' perceived competence in recognizing and managing symptoms and treatment of LAST. Confidence is assessed through self-reported measures evaluating how providers rate their abilities before and after participating in simulation-based training sessions. Improved clinical confidence is critical as it contributes significantly to quicker recognition, timely intervention, and effective crisis management during LAST events, ultimately leading to better patient outcomes (Ackerman et al., 2023).

Search Strategy and Results

A comprehensive literature search was conducted using published literature from multiple online medical databases. These databases included the Cochrane Database of Systematic Reviews (CDSR), PubMed, and CINAHL Plus (Cumulative Index to Nursing and Allied Health Literature) through EBSCOhost. Additional articles were located through hand searching during the research to ensure relevant articles were not missed. To maintain the relevance of the search, the following search terms were included: “Local Anesthetic Systemic Toxicity”, “LAST”, “regional anesthesia toxicity”, “simulation”, “local anesthesia”, “crisis management”, “lipid emulsion”, “peripheral nerve block”, “cardiotoxicity”. Keyword searches include “perioperative healthcare provider” OR “anesthesiologist” OR “nurse anesthetist” OR “CRNA”, “educational video simulation” OR “simulation-based education”, “knowledge retention” AND “confidence in managing LAST”, “perioperative healthcare provider AND LAST AND video simulation”, “knowledge improvement AND confidence AND LAST

management", "Local anesthetic systemic toxicity AND perioperative AND simulation". The inclusion criteria included studies published in English, within the last 10 years, and involving perioperative healthcare providers. Studies focusing on educational interventions specific to managing LAST, such as simulation-based learning or video-based training, were prioritized. Main exclusion criteria involved studies without simulation interventions and studies involving populations other than perioperative providers.

The initial database search using search terms yielded 98 articles. An additional 9 articles were identified through hand search during the review of individual articles. Of these 107 articles, 23 were removed due to duplication. Out of the 84 remaining articles, 63 were excluded based on a focus on conditions other than LAST (e.g., general anesthesia management), educational interventions that did not involve video or simulation, and studies involving populations other than perioperative healthcare providers. A total of 21 articles were assessed for full-text eligibility. After a full-text review, 13 articles were excluded. Reasons for exclusion included comparisons between non-simulation-based educational interventions, lack of direct focus on LAST crisis management, and studies not measuring knowledge or confidence outcomes. Thus, a total of 8 articles were chosen for this literature review due to relevance to the current study.

Synthesis of Literature

After reviewing the literature related to this topic, a total of eight articles were synthesized to evaluate the impact of simulation-based education on knowledge retention, confidence, and practical readiness in managing LAST. In one assessment a significant knowledge gap was identified among nurses regarding LAST signs, symptoms, and treatment, underscoring the need for targeted training (Ferry & Cook, 2021). Simulation based education has emerged as a key

strategy to bridge the knowledge gap, providing a safe and well controlled environment in which providers can practice recognizing and treating a LAST event without risk to patients (Bevil et al., 2020). By simulating a crucial scenario that may otherwise seldom be encountered, these interventions aim to improve both the competence and confidence of perioperative staff in managing LAST should it occur.

A consistent finding across the literature was simulation-based training drastically improving clinicians knowledge of LAST and creating confidence in these skills over time. Participants in multiple studies demonstrated significantly higher post training test scores on LAST recognition and management, as well as many programs showing that knowledge improvements persisted at follow-up assessments months later (Bevil et al., 2020; White et al., 2024). For example, a realistic simulation for perioperative nurses led to immediate increases in test scores, and those scores then remained elevated at both the one-month and three-month posttests compared to their baseline scores (Bevil et al., 2020). Similarly, a multidisciplinary simulation initiative at an outpatient surgery center increased mean knowledge scores of their perioperative staff from 4.76/7.00 before training to 6.34/7.00 after, which was also improved and sustained nine months later to 6.19/7.00 from the baseline score of 4.76/7.00 as previously stated (White et al., 2024). Notably, even an educational intervention delivered solely via an online module produced over a 50% improvement in nurses LAST knowledge, which was retained at a six month follow up review (Ferry & Cook, 2021). These results suggest that designed educational interventions, especially those involving high fidelity simulation, are effective in promoting both immediate learning and long-term retention of critical knowledge about LAST recognition and treatment.

In conjunction with knowledge gains, simulation training consistently increased the

confidence and capability of perioperative providers in handling a LAST emergency. Across different studies, clinicians reported feeling better prepared to act upon a true LAST emergency after engaging in realistic simulated LAST scenarios (Ackerman et al., 2023; White et al., 2024). In an outpatient setting, a simulation led exercise marked increases in staff confidence for managing LAST with the focus topics being confidence levels in symptom recognition, initiating lipid rescue therapy, and coordinating care all of which positively increased by at least 20% after the didactic plus simulation intervention (Ackerman et al., 2023). Also, over 90% of the staff in participation felt an overall improvement in their ability to recognize and manage LAST following the training, compared to their self-assessed ability beforehand (Ackerman et al., 2023). In congruence with the previous study, a study by White et al.,(2024) found that providers reported feeling more confident and knowledgeable after undergoing a simulation-based education program, and even requested that regular simulation sessions be instituted to continually reinforce their preparedness. This enhanced confidence is a crucial outcome, as higher self-efficacy can translate into more decisive and effective actions during an actual perioperative crisis.

Beyond individual knowledge and confidence, simulation-based training improves overall team dynamics and practical readiness. Many of the simulation interventions were performed by a multitude of perioperative providers, such as anesthesiologists, nurses, CRNAs, and other perioperative employees working together through the simulated LAST scenario. Participants have noted that utilizing simulation education improved team dynamics by helping clarify roles, improve communication, and build trust among team members (Ackerman et al., 2023). This aligns with broader evidence that interprofessional simulation training can have positive impacts on collaborative practice, helping participants develop the shared knowledge,

skills, and attitudes needed for effective teamwork in acute situations (Paige et al., 2015). By training together, team members become familiar with each other's roles and communication patterns during a crisis, improving their practical readiness for actual patient care emergencies.

Most institutions employed high fidelity simulations supplemented by either brief lectures or debriefings, while others explored alternatives for teaching critical event management. Erlinger et al. (2021) compared traditional high-fidelity simulations with virtual simulations for student nurse anesthetists, finding that less experienced students recognized myocardial infarction signs faster with mannequin-based scenarios compared to virtual ones. However, more experienced students performed equally well regardless of the method used. Similarly, Ackerman et al. (2023) used a hybrid educational model combining both an academic lecture with hands on simulation for LAST training, significantly improving the participants' diagnostic skills, management prioritization, and self-confidence. Shin et al. (2015) reinforced these findings through a meta-analysis demonstrating that high fidelity simulations provided substantial benefits for developing the psychomotor skills and clinical judgment in nursing education. In contrast, Ferry and Cook (2021) studied an entirely web based learning module, effectively increasing theoretical knowledge about LAST but lacked the interactive hands-on simulation training essential for psychomotor skill development. Lastly, White et al. (2024) implemented a simulation plus e-learning module into new employee orientations and annual competency training, reinforcing LAST management skills continuously. These blended approaches optimize the convenience of online education and the realism of simulation practice. Collectively, these studies emphasize the benefits of using multimodal approaches, combining virtual access with the realistic experience of immersive simulations.

Despite promising outcomes, several limitations were evident across the reviewed

studies. Many of the interventions were small-scale and conducted at single sites, which restricts their generalizability and introduces potential selection biases (Ackerman et al., 2023). The absence of true control groups makes it challenging to directly link improvements to simulation training, although the consistent and significant enhancements indicate a real effect. Due to the infrequency of LAST, studies were unable to assess actual patient outcomes or provider performance in real emergencies; they instead depended on indirect measures such as knowledge assessments and self-reported confidence levels (White et al., 2024). Additionally, high-fidelity simulations demand considerable resources and logistical planning, which can hinder wider implementation (Paige et al., 2015).

Summary of Literature Findings

The review of the literature strongly supports the integration of simulation-based education as an essential tool for training perioperative providers in the management of LAST. Simulation-based education significantly improves knowledge retention and confidence, equipping providers to handle rare but critical emergencies like LAST. Studies consistently demonstrated that these training methods not only enhanced immediate understanding but also improved sustained knowledge over time, with measurable improvements persisting up to nine months post-intervention. Additionally, participants reported increased confidence in recognizing and responding to LAST, a critical factor for timely intervention and patient safety. Current research highlights the adaptability of simulations across various healthcare environments, offering a practical and scalable solution to bridge the educational gaps in LAST management. Based on these findings, it is recommended that healthcare institutions incorporate simulations into standard educational practices to enhance provider readiness, promote interprofessional collaboration, and ultimately improve patient outcomes.

Project Objectives

The objectives of this Doctorate of Nursing Practice (DNP) project are as follows:

(1) Develop an educational video simulation intervention, designed specifically for perioperative healthcare providers, which focuses on the recognition, management and treatment of LAST.
(2) Identify current knowledge and confidence in perioperative healthcare providers in diagnosing, managing and treating LAST prior to viewing the educational video
(3) Measure changes in knowledge and confidence in perioperative healthcare providers in diagnosing, managing and treating LAST immediately after educational presentation and simulation.
(4) Enhance the current standard of care among perioperative healthcare providers by integrating evidence-based simulation education to improve recognition, confidence, and management of LAST, ultimately promoting patient safety and clinical excellence.

Theoretical Framework

This project represents a focused quality enhancement effort aimed at systematically addressing clinical safety and improving healthcare delivery related to LAST. Due to the rarity and clinical complexity of LAST, perioperative clinicians frequently exhibit gaps in critical knowledge, including immediate recognition, effective management, and appropriate treatment strategies. Recognizing the necessity for targeted educational interventions, this project applied the structured Plan-Do-Study-Act (PDSA) methodology, facilitating an organized, evidence-based approach to implementing meaningful improvements within perioperative practice (Moran et al., 2024). The initial "Plan" phase involved assessing baseline clinician competencies,

knowledge, and confidence regarding LAST management via a pre-intervention questionnaire. In the subsequent "Do" phase, clinicians engaged with a specialized simulation-based educational video depicting the clinical progression of LAST, immediate treatment steps, medication requirement, and management strategies utilizing established cognitive aids, specifically the ASRA checklist. Additionally, a concise, practical quick reference tool was provided for use in real-time clinical scenarios. In the "Study" phase, the project's effectiveness was measured by administering post-intervention questionnaires to evaluate clinician improvements in knowledge, self-assessed confidence, and overall satisfaction with the educational resources. These results were then analyzed systematically to determine the educational intervention's impact and clinical relevance. The final "Act" phase included dissemination of project findings and integration of the newly developed educational tools into regular clinical training and professional development activities at Corewell Health Beaumont Grosse Pointe Hospital. The results were presented in educational workshops and shared electronically, ensuring sustained improvement and fostering ongoing clinician engagement and proficiency in managing LAST. Through this structured and iterative quality improvement process, the project bridges existing knowledge gaps, enhanced clinician preparedness, elevated patient safety standards, and ultimately promoted excellence in perioperative healthcare delivery related to LAST management.

Methodology

Project Design

This project followed a quantitative, quasi-experimental design using a pre-test and post-test format to measure the impact of an educational video simulation on local anesthetic systemic toxicity. The intervention was carried out at Corewell Health Beaumont Grosse Pointe Hospital, with the goal of evaluating changes in knowledge and confidence among perioperative providers.

The simulation video used for the intervention was created and recorded at the Eugene Applebaum Simulation Center at Corewell Health William Beaumont University Hospital to ensure realistic, high-quality educational content. This evidence-based quality improvement project is guided by the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Model, which provides a systematic framework for translating current evidence into clinical practice to enhance patient outcomes (Dang et al., 2022). The model followed three essential phases: Practice Question, Evidence, and Translation, all of which support the integration of best practices into healthcare environments. This framework served as a foundation and guide for the creation and implementation of this project, which focuses on improving perioperative healthcare providers knowledge and confidence in managing LAST. In the question phase, a PICO question was developed to address whether an educational video simulation on LAST leads to improved knowledge and confidence compared to current educational protocols. During the evidence phase, a comprehensive literature review was conducted to identify and critically appraise research supporting the efficacy of video-based simulation education in clinical crisis management. Finally, in the translation phase, the project incorporated a pre- and post-test design to evaluate the educational intervention's effectiveness. The data collected helped determine whether the simulation-based approach supported a need for change in current educational strategies for LAST management among perioperative providers.

Project Setting

This project took place at Corewell Health Beaumont Grosse Pointe Hospital - Grosse Pointe, Michigan.

Key Personnel and Stakeholders

This project included several key stakeholders. Primarily, the chief nurse anesthetist, nurse educator, and the chief anesthesiologist who are central to the project, as their clinical

expertise and participation were essential for both the educational simulation and the evaluation process. Certified Registered Nurse Anesthetists (CRNAs), Anesthesiologists and perioperative nursing providers also contributed to the multidisciplinary approach required for effective LAST management. The Quality Improvement (QI) director oversaw project alignment with institutional goals and assisted with data analysis. Support from educators or simulation staff aided in delivering the video simulation and managing pre- and post-tests.

Participants/Population

The target population for this project included perioperative healthcare providers at Corewell Health Beaumont Grosse Pointe Hospital, specifically preoperative and postoperative nursing staff. These participants were selected due to their direct role in the administration, monitoring, and management of local anesthetics in the surgical setting. Inclusion criteria required participants to be currently employed in the perioperative department and involved in direct patient care during surgical procedures. Participation was voluntary, and individuals were invited to complete both a pre-test and post-test in conjunction with viewing a brief educational video simulation on LAST.

Recruitment Strategies

Participants for this project were recruited through a combination of email communication, management support, and interpersonal communication within the perioperative departments at Corewell Health Beaumont Grosse Pointe Hospital. The hospital holds regularly scheduled monthly staff meetings, which provided an ideal opportunity to introduce and deliver the educational video simulation on LAST. Presenting the content during one of these scheduled meetings allowed for maximum exposure and participation among perioperative nursing staff. To encourage involvement, the simulation and accompanying pre- and post-tests were designed to

be concise and easily accessible, minimizing disruption to workflow while still providing meaningful education. This format helped overcome potential recruitment barriers and allowed for broader participation.

Data Collection Instruments

Participants were provided with a comprehensive data collection tool consisting of three primary sections: demographic information, a 13-item self-assessment, and a 12-question knowledge quiz (Appendix A). The demographic section collected data on education level, professional experience, and previous exposure to LAST events. The self-assessment used a five-point Likert scale (1: *Strongly Disagree* to 5: *Strongly Agree*) to measure baseline confidence and perceived knowledge regarding LAST protocols. Finally, clinical knowledge was evaluated through a 12-question multiple-choice quiz . The pre- and post-intervention assessments were identical in content and formatting, including the specific Likert options provided; the only modifications were the randomized sequencing of the questions and their corresponding answer choices to minimize recall bias.

Steps for Project Implementation

After the LAST educational simulation video was finalized, it was introduced to a group of perioperative healthcare providers at Corewell Health Beaumont Grosse Pointe Hospital. This was approved by the chief CRNA, Chief Anesthesiologist, as well as the Preoperative/PACU manager at the given facility. During a scheduled departmental meeting, participants were provided with an overview of the project's background, purpose, and clinical relevance. Before viewing the simulation, participants were asked to complete a pre-test to assess their baseline knowledge and confidence in managing local anesthetic systemic toxicity. Following the pre-

test, the educational video was shown, featuring a simulated LAST scenario along with evidence-based content on recognition, treatment protocols, and crisis management strategies. Immediately after the video, participants completed a post-test to evaluate knowledge gained and changes in confidence. A brief Q&A session was held afterward to clarify any questions and reinforce key takeaways. All pre- and post-test responses were collected and securely stored for data analysis as part of the project outcomes.

Potential Barriers to Implementation and Sustainability

A number of potential challenges were identified prior to implementation. These included obtaining Institutional Review Board (IRB) approval (Appendix D), securing departmental support, coordinating of clinical schedules, accessing the simulation lab for filming, and ensuring accurate video editing, and the incompleteness of pre/post-tests. Long-term sustainability may be affected by staff turnover, necessitating continuous training efforts and cost associated toward educational material for staff.

Ethical Considerations and Risks

This quality improvement project involved minimal ethical risks as it focused on provider education rather than direct patient intervention. No patient health information or direct patient care data was accessed or used. Participation in the educational intervention and the pre/post-assessments was voluntary for all perioperative healthcare providers. To ensure confidentiality and anonymity, all assessment data collected was masked; pre- and post-tests were not linked and there was no collecting of personal identifiers, thus protecting participant privacy. Implied consent was obtained through the voluntary completion of the pre-test or survey. Collective results, rather than individual scores, were reported to prevent any professional repercussions. The primary ethical consideration was ensuring the educational content was accurate, evidence-

based, and presented professionally and respectfully. IRB determination confirming the project as a quality improvement initiative was secured from Oakland University and the affiliated clinical facility (Corewell Health Beaumont Grosse Pointe Hospital) prior to data collection and project implementation. The investigators had no financial relationships with manufacturers of local anesthetics or lipid emulsion, eliminating conflicts of interest.

Potential Benefits and Outcomes

The primary potential benefit of this educational intervention was an anticipated immediate and sustained improvement in perioperative healthcare providers' knowledge and confidence in recognizing and managing a LAST event. Enhanced provider preparedness can lead to quicker recognition of LAST symptoms, more timely initiation of appropriate treatment, and improved adherence to established ASRA protocols. Ultimately, this aimed to enhance patient safety and potentially reduce the severity of adverse outcomes and morbidity associated with LAST. Patients stand to benefit indirectly through more rapid identification of toxicity and faster deployment of lipid therapy. For the health system, earlier and effective treatment could translate into avoided intensive care admissions, reduced healthcare costs associated with managing LAST complications, and potential litigation costs. The project also promoted interprofessional collaboration by involving various perioperative team members in the simulation-based learning experience, which can improve teamwork and communication during real life critical events. Successful implementation may also enhance the standardization of LAST response protocols and increase staff satisfaction with educational training.

Proposed Timeline

The project timeline was structured for systematic development, implementation, and evaluation, which started in the third quarter of 2024 and was implemented in the first quarter of 2026. The initial planning, including literature review, proposal development, and securing necessary approvals (QI/IRB determination, site permissions) was completed by the third quarter of 2025. The subsequent phase involved finalizing the script, reserving the simulation center, filming the LAST simulation video, and drafting surveys, which was completed in the second quarter of 2026. Full implementation of the educational intervention, including administration of pre-tests, viewing of the simulation video, and completion of post-tests, was conducted during a single session within scheduled departmental meetings to maximize participation and minimize disruption. Those that were not able to attend the single session, were contacted by the education coordinator as well as the project faculty chair and were provided the educational material and surveys in subsequent weeks. Data was collected and completed in the second quarter of 2026. Data collection occurred immediately before and after the intervention. Subsequent weeks were allocated for data cleaning, data entry, statistical analysis, and interpretation of results. Finally, the development of the final DNP project report, presentation of results to OR leadership and stakeholders was completed in the third quarter of 2026.

Anticipated Resources, Budget, and Funding Plan

This project was designed to be low-cost, leveraging extensive existing institutional resources, thus requiring minimal to no external funding. Primary resources included access to simulation facilities (i.e., Eugene Applebaum Simulation Center), statistician consultation, simulation equipment, and audiovisual recording and editing software, much of which was available without charge through hospital media services or university agreements. Consumable resources included printing pre/post-test questionnaires.

Analysis Plan for Evaluating Project Outcomes

The effectiveness of the educational video simulation intervention was evaluated using a quantitative, pre-post intervention design. Data was collected from participating perioperative healthcare providers and exported from the collection tool (Appendix A) into statistical software for analysis. Descriptive statistics were used to summarize participant demographics and baseline knowledge/confidence levels. The primary analysis involved comparing the mean scores of knowledge-based questions and self-reported confidence ratings (assessed via a 5-point Likert scale) between pre-test and post-test. Throughout implementation, a Plan-Do-Study-Act log was maintained to document fidelity, barriers encountered, and recommended refinements for future cycles, aligning with DNP project evaluation criteria.

Results

Sample Size, Demographics, and Response Rate

A total of 40 completed assessments were included in the evaluation, consisting of a pre-intervention cohort (n = 24) and a post-intervention cohort (n = 16). Although some nursing staff participated in both phases of the project, the responses were evaluated as independent groups. Demographically, most respondents in both cohorts held a Bachelor of Science in Nursing (BSN) degree (66.7% pre, 56.3% post) and had greater than five years of overall clinical experience (91.7% pre, 87.5% post). The majority of the staff were employed full-time (70.8% pre, 68.8% post) and had not recently treated a patient for the targeted toxicity (91.7% pre, 93.8% post). To objectively evaluate the project's goals of improving toxicity management knowledge and staff confidence, two quantitative assessment tools were utilized. Knowledge was evaluated using a 12-item binary scoring system, where each correct response received 1 point for a total possible score of 12. Participant confidence was measured using a 13-item survey scored on a 5-point

Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree), yielding a total possible score range of 13 to 65.

Statistical Analysis of Findings

Independent samples t-tests were conducted to discern a statistical difference between the pre-intervention and post-intervention means for both the knowledge and confidence goals. For the knowledge goal, the mean score for the post-intervention cohort (M = 10.6, SD = 1.20) was higher than for the pre-intervention cohort (M = 8.5, SD = 1.14). The difference in knowledge scores was statistically significant ($p \leq 0.05$) with a large effect size (Cohen's d = 1.8), indicating the intervention was effective with an overall score increase（See Table 1). Item-level analysis of the 12 knowledge questions revealed substantial improvements, particularly on Question 8, which increased from 33.3% to 56.2% correct, and Question 7, which improved from 41.7% to 81.3% correct. Half of the assessment items achieved a 100% correct response rate in the post-intervention group.

Table 1

Comparison of Knowledge and Confidence Scores Between the Pre- and Post- Cohorts (n=40)

	Groups	N	Mean	Std. Deviation	Minimum	Maximum	P value
Knowledge Score	**Pre**	24	8.5	1.14	7	11	0.05
	Post	16	10.6	1.20	8	12	
Confidence Levels	**Pre**	24	27.4	3.90	20	35	0.05
	Post	16	47.6	2.45	44	53	

Note: Values are presented as Mean and Standard; Deviation - Cohen d value is 1.8 which is a large effect size

For the confidence goal, the independent samples t-test also revealed a statistically significant improvement ($p \leq 0.05$). The post-intervention group reported a markedly higher mean confidence score (M = 47.6, SD = 2.45) compared to the pre-intervention group (M = 27.4, SD = 3.90). The median confidence score similarly increased from 28 (IQR: 24, 30) before the intervention to 47 (IQR: 46, 50) after the intervention (See Table 2). Overall, the statistical analyses indicated that the educational intervention yielded a statistically significant enhancement in both objective knowledge and self-reported confidence among the nursing staff.

Table 2

Comparison of Knowledge and Confidence Scores Between the Pre- and Post- cohorts (n=40)

		Median (Q1,Q3)	**P value**
Knowledge Score	**Pre**	8 (8, 9)	0.05
	Post	11 (10, 12)	
Confidence Levels	**Pre**	28 (24, 30)	0.05
	Post	47 (46. 50)	

Note: Values are presented as Median Interquartile Range

Discussion

Summary of the Problem

Local Anesthetic Systemic Toxicity is a rare but highly lethal complication associated with the administration of local anesthetics, most frequently occurring during regional anesthesia. Because LAST incidents are infrequent, affecting approximately 0.03% of cases, perioperative healthcare providers rarely encounter the complication in their daily practice. This

lack of routine exposure creates a critical gap in clinical preparedness. When a LAST event does occur, delayed recognition of the central nervous system and cardiovascular symptoms can lead to catastrophic patient outcomes, including cardiovascular collapse, seizures, and death, ultimately leading to immense financial burdens for the healthcare facility. The foundational problem addressed by this quality improvement project was the documented inadequacy in provider knowledge and confidence in promptly diagnosing and managing a LAST crisis, underscoring the need for an effective, evidence-based educational intervention.

Key Findings

The implementation of the targeted educational video simulation yielded positive outcomes, successfully achieving the project's objectives of enhancing both knowledge and confidence among perioperative staff. While the results section details the specific statistical data, the clinical implication of these findings is profound.

First, the substantial increase in post-intervention knowledge scores (yielding a large effect size of Cohen's $d = 1.8$) indicated that the video simulation effectively translated complex crisis management protocols into understandable, retainable information. Notably, improvements on assessment items related to lipid emulsion dosing and the immediate steps of crisis management showed that providers are now better equipped with the cognitive tools required to act effectively.

Furthermore, the dramatic improvement in self-reported confidence, nearly doubling from the pre-intervention to the post-intervention cohort, is arguably just as critical as the objective knowledge gained. In high-risk, life-threatening emergencies like LAST, hesitation from low confidence can delay life-saving interventions. By equipping providers with a visual, realistic simulation and a cognitive aid (the ASRA checklist), helped bridge the gap between

theoretical knowledge and practical application, allowing nurses to respond proactively rather than reactively.

Relationship of Findings to the Literature

The outcomes of this project strongly aligned with the existing body of literature regarding clinical education, cognitive aids, and crisis management. Prior studies have consistently demonstrated that perioperative clinicians often exhibit baseline knowledge deficits regarding rare emergencies like LAST. Consistent with findings by Bevil et al. (2020) and White et al. (2024), this project confirms that targeted educational interventions utilizing organized cognitive aids, specifically the ASRA checklist outlined by Neal et al. (2018), significantly improve clinician readiness and compliance with established hospital protocols.

Furthermore, the substantial increase in objective knowledge scores observed in this project paralleled the success of other multimedia and simulation-based educational initiatives. For example, Ferry and Cook (2020) demonstrated that web-based learning modules could improve nurses' LAST knowledge by more than 50%. The large effect size (Cohen's d = 1.8) seen in this project’s post-intervention cohort corroborates these findings, proving that video-based simulation is a highly effective modality for rapidly transferring complex clinical knowledge to real time results. A supported meta-analysis by Lei et al. (2022) and Shin et al. (2015) similarly support this, emphasizing that high-fidelity simulation teaching significantly elevates nursing students' and professionals' knowledge, clinical abilities, and psychomotor skills compared to traditional didactic learning.

Perhaps most importantly, the dramatic improvement in self-reported confidence among participants mirrored recent specialized research. Ackerman et al. (2023) found that multidisciplinary simulation of LAST directly improved both diagnostic skills and self-

confidence among staff. In high-risk, life-threatening emergencies, hesitation from low confidence can delay life-saving interventions such as lipid emulsion therapy. By recreating a high-stress environment through video simulation, this project successfully prepared perioperative staff for practical application. Ultimately, these findings reinforce the consensus in the current literature (Erlinger et al., 2023; Paige et al., 2013) that immersive, simulation-based learning is an optimal and necessary strategy for improving interprofessional team confidence and mitigating the risks of high-acuity, low-occurrence clinical events.

Discussion of Facilitators and Barriers

The successful implementation of this project was driven by several key facilitators. Support from departmental leadership, including the anesthesia leaders as well as the perioperative department managers at Corewell Health Beaumont Grosse Pointe Hospital, was instrumental in securing time during scheduled departmental meetings for staff to participate. Additionally, access to the Eugene Applebaum Simulation Center at Royal Oak Beaumont and quality audiovisual recording equipment allowed for the creation of a realistic, professional-grade educational video without incurring significant external costs. The high baseline clinical experience of the nursing staff (the majority having over five years of experience) also facilitated deep engagement with the advanced clinical concepts presented in the video.

Despite these facilitators, several barriers were encountered, most notably the coordination of clinical schedules in a busy perioperative environment. Because the project required ongoing participation, fluctuating staff availability became a significant barrier during the data collection phase. Although the post-test was administered on a primary collection day, several nurses who participated in the pre-intervention phase were unavailable on the unit. To maximize participation, additional efforts were made to administer and collect post-tests over

subsequent days throughout the following weeks. However, even with these extended collection efforts, some pre-test participants were ultimately unable to complete the post-assessment due to their clinical schedules or unavailability. This logistical reality resulted in attrition and an uneven sample size between the pre-intervention (n=24) and post-intervention (n=16) cohorts. Regardless, the team adapted the statistical analysis plan, utilizing independent samples t-tests rather than paired t-tests to evaluate the data. Nevertheless, the Plan-Do-Study-Act (PDSA) framework utilized for this project allowed the team to adjust to these clinical scheduling challenges, and sufficient statistical power was maintained to successfully validate the intervention's outcomes.

Sustainability of Proposed Changes

For quality improvement initiatives to be truly impactful, they must be sustainable beyond the initial implementation phase. The design of this project inherently promoted long-term sustainability due to its low-cost nature and minimal reliance on external funding. To maintain the improvements in knowledge and confidence, it was recommended that the LAST video simulation be integrated into the hospital’s standard educational curriculum, specifically during the onboarding of new perioperative staff and as part of annual competency training for existing employees. Staff turnover remains an ongoing threat to unit-wide preparedness so therefore, keeping the video on the facilities learning management system will ensure continuous accessibility. By embedding these evidence-based resources into the clinical environment, the facility can sustain a high standard of patient safety and provider readiness against LAST occurrences for years to come.

Limitations

While this quality improvement project yielded statistically significant outcomes, several

limitations must be acknowledged. The primary limitation was sample size attrition driven by the logistical realities of the clinical environment. Because the intervention was conducted in a busy perioperative setting, fluctuating staff availability and clinical scheduling conflicts became a barrier during data collection. Although 24 participants completed the pre-intervention assessment, only 16 completed the post-intervention assessment. Because the pre- and post-intervention cohorts could not be perfectly paired 1-to-1, the data had to be evaluated using independent samples t-tests. While a larger, fully paired sample would have provided a more precise measure of individual knowledge retention, it is important to note that the decision to use unlinked data was intentional. Pairing the assessments could have created a dichotomy between achieving higher statistical accuracy and the risk of identifying individuals who performed poorly, which could then be perceived as disciplinary data rather than an educational tool . Therefore, anonymity was prioritized to protect participant privacy and encourage honest engagement, even though it necessitated the use of less sensitive independent statistical analysis.

A second limitation is the single-center design and the use of a convenience sample. The project was implemented exclusively among the perioperative staff at Corewell Health Beaumont Grosse Pointe Hospital. Because organizational cultures, baseline educational requirements, and institutional resources vary widely across different health systems, the results of this intervention may not be entirely generalizable to other hospitals or non-perioperative departments (such as emergency or labor and delivery units) where LAST might also occur. Furthermore, the quasi-experimental pre- and post-test design lacked a formal control group. Consequently, while the significant improvements in scores are highly correlated with the video simulation, external variables, such as independent outside studying or peer discussions between the pre- and post-test days cannot be entirely ruled out.

Finally, the project relied on surrogate measures to evaluate clinical readiness. Confidence was assessed using a self-reported Likert scale, which is inherently subjective and prone to self-assessment bias. Providers may over- or under-estimate their actual clinical capabilities. Additionally, because LAST is an exceptionally rare clinical event, the ultimate metric of success, improved patient morbidity and mortality during an actual LAST crisis, could not be measured. Additionally, the project utilized paper-based surveys rather than electronic tools to accommodate the workflow of the unit, which necessitated a manual data entry process and limited the ability to automatically pair longitudinal data. The project successfully demonstrated an improvement in theoretical knowledge and simulated confidence; however, future longitudinal studies would be required to determine if these educational gains directly translate into accurate execution during a real-life, high-stress patient emergency.

Recommendations

Based on the successful outcomes of this project, several recommendations can be made for future quality improvement and research initiatives. First, it is highly recommended that this educational video simulation be applied and evaluated in other clinical settings. Because local anesthetics are utilized extensively outside of the perioperative environment, replicating this intervention in relevant settings such as emergency departments, labor and delivery units, and outpatient clinics utilizing regional anesthesia would broaden the impact on patient safety system-wide. Future research should also possibly consider a longitudinal design to measure knowledge and confidence retention at six- and twelve-month intervals, which would help organizations determine the optimal frequency for mandatory LAST retraining.

Implications for Practice and Career Development

The implications of this project for clinical practice are substantial. This initiative

provides a scalable, evidence-based blueprint for addressing critical knowledge gaps surrounding high-acuity, low-occurrence emergencies.

Furthermore, the design, implementation, and evaluation of this DNP project and the accompanying clinical residency have profoundly impacted our personal growth and career development. Navigating the complexities of a clinical quality improvement initiative fostered advanced competencies in interprofessional communication, leadership, and the translation of empirical evidence into bedside practice. Overcoming the logistical barriers of clinical implementation required adaptability and resilience, reinforcing our capabilities as systems-level problem solvers. Ultimately, this scholarly journey has solidified our commitment to lifelong learning and equipped us with the foundational leadership skills necessary to drive meaningful organizational change as doctorally prepared clinical leaders.

Conclusion

Local Anesthetic Systemic Toxicity is a perilous complication that demands immediate, flawless clinical intervention to prevent catastrophic patient harm. The outcomes of this quality improvement project successfully demonstrated that a targeted educational video simulation, paired with evidence-based cognitive aids, is a highly effective strategy for bridging the preparedness gap among perioperative healthcare providers. By significantly increasing both objective clinical knowledge and self-reported confidence, the intervention empowered the nursing staff to proactively recognize and manage a LAST crisis. Ultimately, the integration of this simulation-based education into standard clinical training protocols ensures that the perioperative team remains vigilant, competent, and fully equipped to safeguard patient lives during rare anesthetic emergencies.

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Appendix A - Data Collection Tool

PRE-TEST

A QUALITY IMPROVEMENT INITIATIVE: A PROVIDER EDUCATION SIMULATION FOR MANAGEMENT AND TREATMENT OF LOCAL ANESTHETIC SYSTEMIC TOXICITY PROTOCOL

Thank you for participating in this quality improvement study for our Doctor of Nursing Practice program at Oakland University. Your participation is completely voluntary and anonymous. This study was approved by the Oakland University Institutional Review Board (IRB) and does not involve human subjects or collect any identifiable data. All responses will be kept confidential and used only for the purpose of this educational quality improvement project.

This quality improvement project aims to determine if an educational video simulation improves perioperative healthcare providers' knowledge and confidence in managing a Local Anesthetic Systemic Toxicity (LAST) crisis. LAST is a rare but life-threatening complication, and this educational intervention is designed to enhance provider preparedness and improve patient safety.

If you have any questions about this project, please contact the study authors:

- Nathan Friese, DNP Candidate: nmfriese@oakland.edu
- Sanjay Kuruvilla, DNP Candidate: skuruvilla@oakland.edu

Demographic Information

Please provide the following demographic information. This will only be used for data analysis purposes.

1. What is your highest level of education in healthcare? (Please circle one)

   Associates Bachelors Masters Doctorate

2. How many years of overall healthcare experience do you have? (Please circle one)

   0 – <1 year 1 – <3 years 3 – <5 years >5 years

3. How many years of experience do you have in the OR/perioperative setting? (Please circle one)

   0 – <1 year 1 – <3 years 3 – <5 years >5 years

4. What is your current employment status? (Please circle one)

Full-Time Part-Time Contingent

5. Have you ever treated a Local Anesthetic Systemic Toxicity (LAST) incident before? (Please circle one)

Yes No

Instructions: Please read each statement carefully. For each question, place an "X" in the box that best describes your level of agreement.

Questions	1: (Strongly Disagree); 2 (Disagree); 3 (Undecided); 4 (Agree); 5 (Strongly Agree)				
	1 Strongly Disagree	**2 Disagree**	**3 Undecided**	**4 Agree**	**5 Strongly Agree**
1. I know the maximum doses of all my local anesthetics.					
2. I can recognize the signs/symptoms of LAST.					
3. I know the initial steps in treating a patient with LAST.					
4. I know where the LAST kit(s) is located in my hospital.					
5. I am familiar with the contents in the LAST kit.					
6. I know what the ASRA checklist is and where it is located.					
7. I know the initial bolus dose of lipid emulsion to administer to a patient experiencing LAST.					
8. I know the continuous maintenance dose of lipid emulsion to administer to my patient experiencing LAST					
9. I know the modified ACLS medication doses for LAST.					
10. I know what ACLS medications to avoid during LAST.					
11. I feel confident in managing a patient experiencing LAST.					
12. I feel confident in managing cardiac arrest during LAST.					
13. I feel knowledgeable in managing experiencing LAST					

Toxicity (LAST) Management Quiz

Question 1: What are common early central nervous system (CNS) symptoms of Local Anesthetic Systemic Toxicity (LAST)?

A) Metallic taste, tinnitus, agitation
B) Bradycardia, hypotension, skin rash

C) Hyperglycemia, muscle weakness, fever
D) Chest pain, dyspnea, cyanosis

Question 2: What are potential early cardiovascular signs of LAST?

A) Hypertension initially, then hypotension; tachycardia initially, then bradycardia/asystole
B) Immediate and profound bradycardia and hypotension
C) Only ventricular arrhythmias without blood pressure changes
D) Warm, flushed skin and bounding pulses

Question 3: Which of the following patient factors significantly increases the risk of developing LAST?

A) Patient with severe cardiac disease (e.g., low ejection fraction)
B) Young, healthy adult with no comorbidities
C) Patient with a high pain tolerance
D) Patient with a history of opioid use

Question 4: What is a key strategy for preventing LAST?

A) Using the lowest effective dose of local anesthetic and aspirating before injection.
B) Administering a benzodiazepine prophylactically to all patients.
C) Choosing a local anesthetic with the highest pKa.
D) Pre-hydrating the patient with intravenous fluids.

Question 5: When do symptoms of Local Anesthetic Systemic Toxicity (LAST) most commonly appear following a local anesthetic injection?

A) Typically within 1-5 minutes, but can be delayed up to 60 minutes or more.
B) Always immediately, within 30 seconds of injection.
C) Usually several hours after the procedure is completed.
D) Only after the local anesthetic has completely worn off.

Question 6: What is the primary mechanism by which local anesthetics cause systemic toxicity in the central nervous system and cardiovascular system?

A) Blockade of sodium channels in the CNS and myocardium.
B) Activation of opioid receptors leading to respiratory depression.
C) Inhibition of acetylcholinesterase at the neuromuscular junction.
D) Release of excessive histamine causing vasodilation and shock.

Question 7: A 70kg adult patient without cardiac arrest shows signs of LAST. What is the initial recommended administration of 20% lipid emulsion therapy?

A) 20% Lipid Emulsion: 1.5 mL/kg bolus over 1 minute, then infusion at 0.25 mL/kg/min.
B) 20% Lipid Emulsion: 1.0mL/kg bolus over 1 minute, then infusion at 0.15 mL/kg/min.
C) 20% Lipid Emulsion: 0.5mL/kg bolus over 1 minute, then infusion at 0.2mL/kg/min.
D) 20% Lipid Emulsion: 0.25mL/kg/min without bolus.

Question 8: During cardiopulmonary resuscitation (CPR) for a Local Anesthetic Systemic Toxicity (LAST) event in a 70kg adult, what is the recommended initial approach with

20% lipid emulsion?

A)20% Lipid Emulsion: 1.5 mL/kg IV bolus, followed by an infusion at 0.25 mL/kg/min. Do not repeat the bolus.
B) 20% Lipid Emulsion: A continuous infusion of 1.0 mL/kg/min should be started immediately. No bolus is required.
C) 20% Lipid Emulsion: 1.5 mL/kg IV bolus, which may be repeated up to two times for persistent asystole, followed by an infusion at approximately 0.5 mL/kg/min.
D) 20% Lipid Emulsion: 3.0 mL/kg IV bolus, which may be repeated once, followed by an infusion at 0.5 mL/kg/min.

Question 9: What is the primary goal of airway management in a patient experiencing LAST?

A) Ensure oxygenation and prevent hypoxia and acidosis.
B) Prepare for immediate cricothyrotomy on all patients.
C) Administer 100% nitrogen to displace oxygen.
D) Delay airway management until lipid emulsion is given.

Question 10: Which medication is preferred for managing active seizures caused by Local Anesthetic Systemic Toxicity?

A) Benzodiazepines (e.g., lorazepam, midazolam)
B) Propofol in large boluses
C) Phenytoin or Fosphenytoin
D) Succinylcholine to stop motor activity.

Question 11: In managing cardiac arrhythmias or cardiovascular collapse due to LAST, which of the following medications should generally be AVOIDED or used with extreme caution due to potential for worsening the situation?

A) Calcium channel blockers and beta-blockers
B) Lipid emulsion therapy
C) Oxygen
D) Benzodiazepines for seizure control

Question 12: Which of the following options places the initial steps for managing a Local Anesthetic Systemic Toxicity (LAST) crisis in the correct order?

A) 1. Stop injection, 2. Call for help, 3. Airway management (Oxygen/Ventilate), 4. Control Seizures (Benzodiazepine), 5. Administer 20% Lipid Emulsion, 6. Cardiovascular support/CPR.
B) 1. Administer 20% Lipid Emulsion, 2. Stop injection, 3. Airway management, 4. Call for help, 5. Control Seizures, 6. Cardiovascular support/CPR.
C) 1. Stop injection, 2. Airway management, 3. Control Seizures, 4. Administer 20% Lipid Emulsion, 5. Cardiovascular support/CPR, 6. Call for help.
D) 1. Stop injection, 2. Call for help, 3. Control Seizures, 4. Airway management, 5. Administer 20% Lipid Emulsion, 6. Cardiovascular support/CPR.

POST-TEST

A QUALITY IMPROVEMENT INITIATIVE: A PROVIDER EDUCATION SIMULATION FOR MANAGEMENT AND TREATMENT OF LOCAL ANESTHETIC SYSTEMIC TOXICITY PROTOCOL

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4. What is your current employment status? (Please circle one)

Full-Time Part-Time Contingent

5. Have you ever treated a Local Anesthetic Systemic Toxicity (LAST) incident before? (Please circle one)

Yes No

Instructions: Please read each statement carefully. For each question, place an "X" in the box that best describes your level of agreement.

Questions	1: (Strongly Disagree); 2 (Disagree); 3 (Undecided); 4 (Agree); 5 (Strongly Agree)				
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1. I know the maximum doses of all my local anesthetics.					
2. I can recognize the signs/symptoms of LAST.					
3. I know the initial steps in treating a patient with LAST.					
4. I know where the LAST kit(s) is located in my hospital.					
5. I am familiar with the contents in the LAST kit.					
6. I know what the ASRA checklist is and where it is located.					
7. I know the initial bolus dose of lipid emulsion to administer to a patient experiencing LAST.					
8. I know the continuous maintenance dose of lipid emulsion to administer to my patient experiencing LAST					
9. I know the modified ACLS medication doses for LAST.					
10. I know what ACLS medications to avoid during LAST.					
11. I feel confident in managing a patient experiencing LAST.					
12. I feel confident in managing cardiac arrest during LAST.					
13. I feel knowledgeable in managing experiencing LAST					

Toxicity (LAST) Management Quiz

Question 1: What is the primary mechanism by which local anesthetics cause systemic toxicity in the central nervous system and cardiovascular system?

A) Inhibition of acetylcholinesterase at the neuromuscular junction

B) Activation of opioid receptors leading to respiratory depression

C) Blockade of sodium channels in the CNS and myocardium

D) Release of excessive histamine causing vasodilation and shock

Question 2: Which of the following patient factors significantly increases the risk of developing LAST?
A) Patient with a history of opioid use
B) Young, healthy adult with no comorbidities
C) Patient with severe cardiac disease (e.g., low ejection fraction)
D) Patient with a high pain tolerance

Question 3: In managing cardiac arrhythmias or cardiovascular collapse due to LAST, which of the following medications should generally be AVOIDED or used with extreme caution?
A) Calcium channel blockers and beta-blockers
B) 20% Lipid emulsion therapy
C) Supplemental oxygen
D) Benzodiazepines for seizure control

Question 4: What are potential early cardiovascular signs of LAST?
A) Hypertension initially, then hypotension; tachycardia initially, then bradycardia/asystole
B) Only ventricular arrhythmias without blood pressure changes
C) Immediate and profound bradycardia and hypotension
D) Warm, flushed skin and bounding pulses

Question 5: Which of the following options places the initial steps for managing a LAST crisis in the correct order?
A) 1. Stop injection, 2. Call for help, 3. Airway management (Oxygen/Ventilate), 4. Control Seizures (Benzodiazepine), 5. Administer 20% Lipid Emulsion, 6. Cardiovascular support/CPR.
B) 1. Administer 20% Lipid Emulsion, 2. Stop injection, 3. Airway management, 4. Call for help, 5. Control Seizures, 6. Cardiovascular support/CPR.
C) 1. Stop injection, 2. Call for help, 3. Control Seizures, 4. Airway management, 5. Administer 20% Lipid Emulsion, 6. Cardiovascular support/CPR.
D) 1. Stop injection, 2. Airway management, 3. Control Seizures, 4. Administer 20% Lipid Emulsion, 5. Cardiovascular support/CPR, 6. Call for help.

Question 6: When do symptoms of LAST most commonly appear following a local anesthetic injection?
A) Only after the local anesthetic has completely worn off
B) Typically within 1-5 minutes, but can be delayed up to 60 minutes or more
C) Always immediately, within 30 seconds of injection
D) Usually several hours after the procedure is completed

Question 7: During cardiopulmonary resuscitation (CPR) for a LAST event in a 70kg adult, what is the recommended initial approach with 20% lipid emulsion?

A) A continuous infusion of 1.0 mL/kg/min should be started immediately with no bolus required
B) 1.5 mL/kg IV bolus, which may be repeated up to two times for persistent asystole, followed by an infusion at approximately 0.5 mL/kg/min
C) 1.5 mL/kg IV bolus, followed by an infusion at 0.25 mL/kg/min; do not repeat the bolus
D) 3.0 mL/kg IV bolus, which may be repeated once, followed by an infusion at 0.5 mL/kg/min

Question 8: What are common early central nervous system (CNS) symptoms of LAST?
A) Hyperglycemia, muscle weakness, and fever
B) Bradycardia, hypotension, and skin rash
C) Chest pain, dyspnea, and cyanosis
D) Metallic taste, tinnitus, and agitation

Question 9: What is the primary goal of airway management in a patient experiencing LAST?
A) Delay airway management until lipid emulsion is given
B) Administer 100% nitrogen to displace oxygen
C) Ensure oxygenation and prevent hypoxia and acidosis
D) Prepare for immediate cricothyrotomy on all patients

Question 10: A 70kg adult patient without cardiac arrest shows signs of LAST. What is the initial recommended administration of 20% lipid emulsion therapy?
A) 0.25 mL/kg/min without a bolus
B) 1.0 mL/kg bolus over 1 minute, then infusion at 0.15 mL/kg/min
C) 1.5 mL/kg bolus over 1 minute, then infusion at 0.25 mL/kg/min
D) 0.5 mL/kg bolus over 1 minute, then infusion at 0.2 mL/kg/min

Question 11: What is a key strategy for preventing LAST?
A) Choosing a local anesthetic with the highest pKa
B) Administering a benzodiazepine prophylactically to all patients
C) Using the lowest effective dose of local anesthetic and aspirating before injection
D) Pre-hydrating the patient with intravenous fluids

Question 12: Which medication is preferred for managing active seizures caused by Local Anesthetic Systemic Toxicity?
A) Phenytoin or Fosphenytoin
B) Succinylcholine to stop motor activity
C) Propofol in large boluses
D) Benzodiazepines (e.g., lorazepam, midazolam)

Appendix B - Evaluation Table

Table 1. Evaluation Table

Author (Year)	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
1. Bevil et al., (2020). Pain Management Nursing, 21(3), 271–275.	None	QES Pre-test and post-test design Purpose: Aims to evaluate knowledge retention regarding LAST in perianesthetic nursing staff using high-fidelity simulation and a short didactic session.	n=13 (perioperative nurses) University of Wisconsin Hospital covering pre-op, post-anesthesia, and block teams. Attrition: 1 nurse (maternity leave)	IV: Simulation intervention (high-fidelity scenario & didactic material) DV: Knowledge retention on LAST management, self-efficacy in crisis scenarios	DV: 20-item multiple-choice test designed by two regional anesthesiologists, one regional anesthesiology fellow and one pain management director.	Logistic mixed-effects regression modeling test performance over four assessments: pre-simulation, post-lecture, 1-month, and 3-month follow-ups Percentages CI	Significant improvement in test scores: 52% pre-simulation 90% post-simulation, 81% 1-month post-simulation 77% 3-month post-simulation Increased participant confidence in crisis management	Strengths: Effective model for LAST training in nursing, high knowledge retention Limitations: Small sample size, no control group. Conclusion: Simulation feasible and adaptable for training on rare but critical

		No exclusion criteria						perioperative events, suitable for similar event-based training needs.
2. Ferry & Cook, (2020). Journal of PeriAnesthesia Nursing, 35(4), 365–367.	None	QES Pre-test and post-test design Web-based self-paced module	n=2,185 (clinical nurses specialties medical-surgical, critical care, ambulatory, and perioperative) Setting: Local hospital in Newark 1,582 completed web-based educational	IV: Web-based LAST education module DV: Knowledge retention on LAST signs, symptoms, and treatment	DV: Pre/post-education surveys assessing knowledge, with an immediate post-test and a 6-month follow-up survey	Comparative percentage analysis of pre/post-education survey responses	Immediate post-education survey showed >50% improvement 6-month survey indicated information retention with 82% knowledge of LAST, 74% of nurses identifying LAST signs/symptoms and 67% identifying	Strengths: Effective large-scale online learning intervention, high retention at 6 months Limitations: Varying survey sample sizes, single delivery method for survey distribution. Conclusion: Feasible

			self-learning modules 369 completed post-education survey questions				treatment correctly	online model for LAST training with potential application for other high-risk low-frequency events.
3. Paige et al., (2015). Surgical Clinics of North America, 95(4), 751–766.	None	Literature review with case examples of simulation-based IPE interventions Purpose: Evaluate the impact of simulation-based education, while promoting better patient outcomes and improving	Not specified sample Setting includes varied healthcare professionals in simulated OR and trauma environments	IV: Simulation-based IPE activities DV: Improvement in team-based skills, interprofessional communication, improving role understanding	Case studies of simulation programs, evaluation based on competencies outlined in IPEC report	Descriptive analysis of IPE impact across clinical settings using examples from different healthcare training programs	Simulation-based IPE led to improved teamwork, communication, and understanding of professional roles among participants, demonstrating positive impacts on collaborative practice.	Strengths: Strong case-based approach highlights effective teamwork in healthcare Limitations: Lack of quantifiable data, focus on descriptive analysis. Conclusion: Simulation-

		role understanding.						based IPE supports team dynamics and role clarity. High adaptability in healthcare education.
4. White et al., (2024) Journal of PeriAnesthesia Nursing, 39(5), 722–728.	None	QES Multimodal educational intervention with simulation Purpose: Education with standardization of LAST care management and sustained improvement in nurses' knowledge of how to	n= 55 (pre- and post-anesthesia nurses) UVA Health Outpatient Surgery Center	IV: LAST education with simulation DV: Knowledge retention and confidence in LAST recognition and management	DV: 5-question knowledge assessment on LAST (pre- and post-intervention) Qualitative feedback from simulation debriefings	One-tailed independent t-test comparing pre- and post-intervention scores over three intervals (1, 3, and 9 months) P-value Qualitative data Mean	Knowledge scores increased from 4.76 to 6.34 (out of 7) post-intervention, sustained at 9-months (6.19, P = .004) Qualitative feedback indicated increased confidence and appreciation for	Strengths: High retention through multimodal training, practical simulation approach Limitations: No real event testing and limited generalizability. Conclusion: Feasible training

		recognize s/s of LAST and how to competently manage a LAST event.					interdisciplinary training	model for rare event readiness, adaptable across clinical settings for patient safety.
5. Ackerman et al., (2023) BMJ Open Quality, 12(2), 1-4.	None	Mixed methods Didactic lecture and high-fidelity simulation Purpose: To acquaint pain clinic staff with current training related to LAST and opportunity to practice in controlled environment.	n=12 (staff members at pain clinic) Pain center associated with Duke Medical Center	IV: Multidisciplinary simulation-based training DV: Knowledge and confidence in LAST diagnosis and management	Pre- and post-simulation survey assessing knowledge of LAST signs, treatment, and self-confidence	Comparative analysis of pre- and post-intervention scores Percentages	Post-simulation confidence scores increased by 20-30 points <1 month reassessment >90% participants reported improved competence in LAST recognition and response	Strengths: High engagement through team-based learning Limitations: Small sample, limited generalizability. Conclusion: Valuable training model for rare emergencies,

								fostering team readiness and role clarity. Potential for adaptation in outpatient and ambulatory settings.
6. Shin et al., (2015) Nurse Education Today, 35(1), 176–182.	None	Meta-analysis of 20 quantitative studies comparing simulation-based education to traditional methods from four separate databases Purpose: To identify the best available evidence about the	20 primary studies Sample includes undergraduate nursing students and clinical nurses	IV: Simulation-based education DV: Knowledge, skill, confidence, and attitude outcomes	Data pooled from studies using varying metrics (e.g., psychomotor, cognitive assessments)	Random-effects model meta-analysis Subgroup analysis based on evaluation methods, learner type, and simulation fidelity level	Simulation-based education showed medium-to-large effect sizes for improved knowledge, skills, and confidence; particularly effective in psychomotor and cognitive skill development	Strengths: Comprehensive analysis, large sample base from multiple studies Limitations: Heterogeneity among study designs, reliance on self-reported outcomes. Conclusion: Supports

		effects of patient simulation in nursing education through a meta-analysis.						integration of simulation in nursing education for diverse clinical skills.
7. Lei et al., (2022) Nurse Education in Practice, 60.	None	Meta-analysis and systematic review	15 studies N=1,332 nursing students from various countries	IV: High-fidelity simulation DV: Knowledge acquisition, professional skills, clinical abilities	SMD values for outcomes from included studies	Random-effects model meta-analysis to address heterogeneity	Significant improvement: Knowledge SMD = 1.37 Professional skills SMD = 0.90 Critical thinking SMD = 0.58 Communication SMD = 2.62	Strengths: Large sample size, diverse population Limitations: High heterogeneity among studies, non-standardized tools. Conclusion: High fidelity simulation is effective in improving nursing competencies, highly

								applicable in nursing education for skill development.
8. Erlinger et al., (2019) AANA Journal, 87(2), 105-109	None	QES Comparing high-fidelity mannequin simulation to virtual simulation	N=39 SRNAs (second- and third-year students)	IV: Type of simulation modality DV: Time to recognize intraoperative MI	Digital timer for recognition time, recorded during both simulation types	Non-parametric tests due to small sample size and non-normal data distribution Mann-Whitney U	Second-year students recognized MI faster with high-fidelity simulation No significant difference for third-year students between modalities	Strengths: Controlled for learning effect, practical application for anesthesia training Limitations: Small sample, single institution. Conclusion: Both simulation methods are effective - high-fidelity preferred for less experienced

								students, virtual simulation may be adequate for advanced students.

Appendix C - Synthesis Table

Table 2. Synthesis Table: Levels and Types of Evidence

	1	2	3	4	6	7	8
Level I: • Experimental study, randomized controlled trial (RCT) • Explanatory mixed methods design that includes only a Level I quaNtitative study • Systematic review of RCTs, with or without meta-analysis					√	√	
Level II: •Quasi-experimental study •Explanatory mixed methods	√	√		√			√

design that includes only a Level II quaNtitative study • Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis							
Level III: • Nonexperimental study •Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or							

nonexperimental studies only, with or without meta-analysis. •Exploratory, convergent, or multiphasic mixed methods studies • Explanatory mixed methods design that includes only a Level III quaNtitative study • QuaLitative study • Systematic review of quaLitative studies with or without meta-synthesis							
Level IV: Opinion of respected authorities and/or			√				

nationally recognized expert committees or consensus panels based on scientific evidence. Includes: • Clinical practice guidelines • Consensus panels/position statements							
Level V: Based on experiential and non-research evidence. Includes: • Scoping reviews • Integrative reviews • Literature reviews • Quality improvement,							

program or financial evaluation • Case reports • Opinion of nationally recognized expert(s) based on experiential evidence							

1 = Bevil et al., (2020); 2 = Ferry & Cook, (2020); 3 = Paige et al., (2015); 4 = White et al., (2024); 5 = Ackerman et al., (2023); 6 = Shin et al., (2015); 7 = Lei et al., (2022) 8 = Erlinger et al., (2019)

Table 3. Synthesis Table: Outcomes

Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Knowledge Improvement	↑	↑	↑	↑	↑	↑	↑	↑
Confidence Improvement	↑	↑	N/A	N/A	↑	↑	↑	↑

Retention of Knowledge (1-month)	↑	NR	N/A	↑	N/A	N/A	N/A	N/A
Retention of Knowledge (3-months)	↑	NR	N/A	↑	N/A	N/A	N/A	N/A
Retention of Knowledge (6-months)	NR	↑	N/A	NR	N/A	N/A	N/A	N/A
Retention of Knowledge (9-months)	NR	NR	N/A	↑	N/A	N/A	N/A	N/A
Simulation Preference	N/A	N/A	↑	N/A	↑	NR	↑	↑
Effectiveness of Educational Method	↑	↑	↑	↑	↑	↑	↑	↑
Feedback Impact on Performance	N/A	N/A	↑	↑	N/A	↑	↑	↑

1 = Bevil et al., (2020); 2 = Ferry & Cook, (2020); 3 = Paige et al., (2015); 4 = White et al., (2024); 5 = Ackerman et al., (2023); 6 = Shin et al., (2015); 7 = Lei et al., (2022) 8 = Erlinger et al., (2019)

N/A = Not Applicable; NR = Not Recorded; ↑ = Increased

Appendix D

Corewell IRB Approval Letter

Corewell Health East

Nursing EBP, Quality and Research Council

Nursing EBP/Quality Application Review
Date: August 12, 2025
To: Nathan Friese, Sanjay Kuruvilla & Hassan Abbas
RE: A Quality Improvement Initiative: Provider Education Simulation for Management and Treatment of Local Anesthetic Systemic Toxicity Protocol

Dear colleagues,

Your EBP/QI application was reviewed by the Corewell Health East Nursing Evidence Based Practice, Quality and Research Council. This council consists of site representatives from all of our sites – including Directors of Education and Research, Magnet Managers, Nursing Professional Development Specialists, Research Institute staff, and various leaders from Corewell Health East. Thank you for participating in the Council review process.

Please obtain the approval signature of CRNA Manager/Director (at bottom of EBP/QI application) and e-mail to me. Also suggested was that you cite the source of any questions you used in your survey that were gleaned from articles.

Your project has been approved. Best wishes on your project and please let me know if I can assist in any way.

Sincerely,

Caroline Medcoff, MSN, RN, NPD-BC, CNN
Chairperson - CHE Nursing EBP, Quality and Research Council

Nursing Professional Development Specialist
Nursing Education, Research & Magnet
William Beaumont University Hospital, Royal Oak

Oakland University IRB Approval Letter

Date: 4-13-2026

IRB #: IRB-FY2025-441
Title: A QUALITY IMPROVEMENT INITIATIVE: A PROVIDER EDUCATION SIMULATION FOR MANAGEMENT AND TREATMENT OF LOCAL ANESTHETIC SYSTEMIC TOXICITY PROTOCOL
Creation Date: 6-20-2025
End Date:
Status: Approved
Principal Investigator: Nathan Friese
Review Board: OU IRB Administrative Board
Sponsor: Corewell Health William Beaumont University Hospital Research Institute

Study History

Submission Type	Review Type	Decision
Initial	Administrative	No Human Subjects Research

Key Study Contacts

Member Hassan Abbas	Role Co-Principal Investigator	Contact hlabbas2@oakland.edu
Member Nathan Friese	Role Principal Investigator	Contact nmfriese@oakland.edu
Member Sanjay Kuruvilla	Role Primary Contact	Contact skuruvilla@oakland.edu