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Instituting an Educational Module to Improve Knowledge of Local Anesthetic Systemic Toxicity Among Anesthesia Providers

Alisha Marie Linehan

University of Tennessee, Knoxville, Amitch38@vols.utk.edu

Chad Andrew McClure

University of Tennessee, Knoxville, Cmclur4@vols.utk.edu

Steven Taylor Moon

University of Tennessee, Knoxville, smoon15@vols.utk.edu

Shukhratilla Ibragimov Shamshitdinov

University of Tennessee, Knoxville, Sshamshi@vols.utk.edu

Julie Newton Bonom

University of Tennessee, Knoxville, jbonom@utk.edu

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Authors

Alisha Marie Linehan, Chad Andrew McClure, Steven Taylor Moon, Shukhratilla Ibragimov Shamshidinov, Julie Newton Bonom, and Jason Michael Buehler



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**Alisha Linehan, Chad McClure,
Steven Moon, &
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**THE UNIVERSITY OF
TENNESSEE
KNOXVILLE**

Background

- Approximately 70 million surgeries annually in the U.S. (Wadlund, 2017)
- Perioperative administration of local anesthetic medications is increasing as multimodal pain management strategies become more popular (Wadlund, 2017)
- Unintentionally high doses or inadvertent intravascular injection of these medications can cause life-threatening complications, such as local anesthetic systemic toxicity (LAST) (Macfarlane et al., 2021)

Problem

- Site data suggests patients may be exhibiting signs of excessive local anesthetic administration during the postoperative period
 - Symptoms like confusion, agitation, cardiac depression and arrhythmias can mimic other conditions like stroke (Nagelhout, 2016)
- Perioperative caregivers unfamiliar with LAST
- No formal LAST education
- Multiple providers administering local anesthetics during multiple phases of the perioperative course with no interdisciplinary communication
- Documented LAST cases are infrequent and randomized clinical trials are unethical (Leskiw & Weinberg, 2009)

Clinical Significance

- Patients who experience a LAST event require rapid interventions, such as administration of lipid emulsion, to prevent devastating side effects (New York School of Regional Anesthesia, 2021)
 - These patients are often misdiagnosed, leading to a greater chance of significant morbidity and mortality (Mahajan & Derian, 2021)
 - Time is potentially wasted performing imaging exams and lab work
- Complications from surgery extend length of stay and possibly require admission to intensive care units (Rapaport et al., 2003)
 - Shorter length of stay has been associated with decreased hospital costs and increased patient satisfaction (Walters et al., 2016)
 - Surgical complications within 30 days reduces the survival rate by 69% (Fawcett et al., 2012)

Project Purpose, and PICO Question

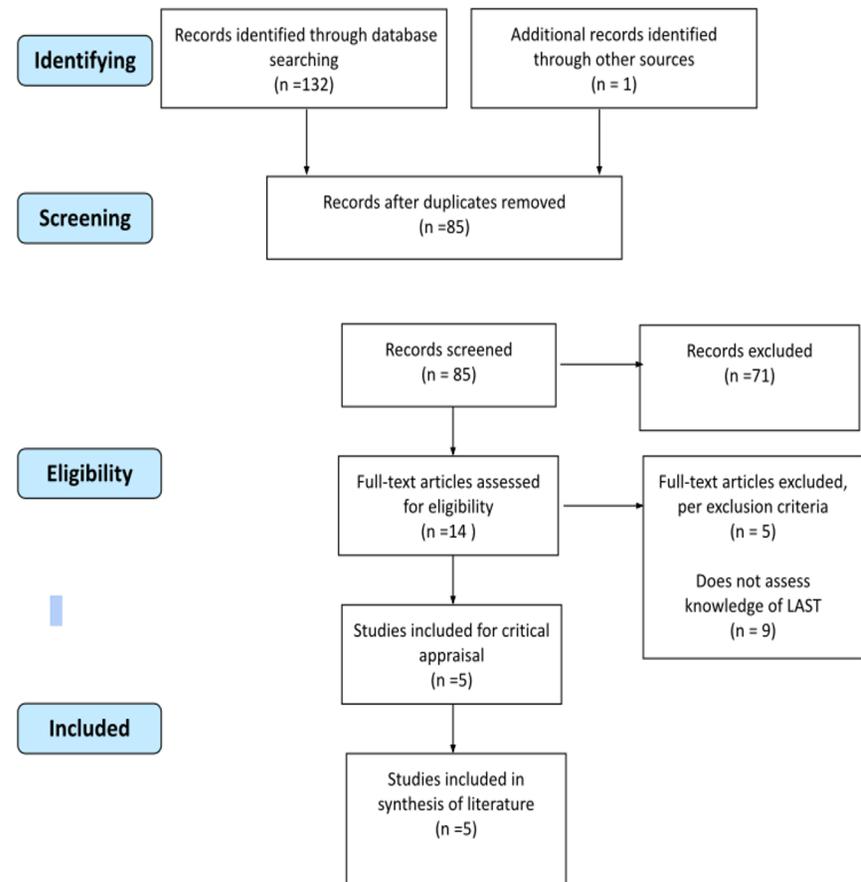
- **Purpose:**
 - To improve CRNA and anesthesia resident knowledge of LAST, including how to prevent, recognize and treat the syndrome. This should decrease the incidence of LAST at the project site by ensuring patients only receive appropriate dosages of local anesthetics and that any patient who does present with LAST is quickly recognized and appropriately treated.
 - This purpose will be measured with an improvement in provider knowledge of LAST as demonstrated by our pre- and post-surveys
- **PICO:**
 - In patient care providers (P), how does the the implementation of local anesthetic systemic toxicity (LAST) education (I), compared to no LAST education (C) affect providers' prevention, recognition, and treatment of patients experiencing LAST (O)?

Literature Review

❖ Search Strategies for Review of the Literature:

- PubMed
- CINHAL
- The Cochrane Library
- The Web of Science and Scopus.

PRISMA Literature Search Flow Diagram



Evidence Synthesis

❖ **Critical Appraisal of the Literature:**

- Johns Hopkins Nursing Evidence Practice Model (JHNEPBM) Research Evidence Assessment Tool.

❖ **Evidence Level and Quality Grades:**

- Level of evidence II, III and V
- Quality of evidence B and A

Evidence Synthesis

Outcome	Bevil et al. (2020)	Ferguson et al. (2019)	Ferry & Cook, (2020)	Oksuz et al, (2018)	Sagir & Goyal (2014)
Knowledge of LAST Prevention before intervention	↓	↓	∅	↓ ^s	↓ ^s
Recognition of LAST before intervention	↓	↓	↓	↓ ^s	↓ ^s
Knowledge of Treatments of LAST before intervention	↓	↓	↓	↓ ^s	↓ ^s
Knowledge increase with education of LAST prevention, recognition, and treatments	↑ ^c	↑ ^s	↑ ^c	∅	∅
Sample Size	12	70	1582	600	200
Level of Evidence	III	II	V	III	III
Quality of Evidence	B	B	B	A	A

Legend: ↓=decrease; ↑=increase; ∅=not discussed in study; LAST= Local Anesthetics Systemic Toxicity, NA= Not Applicable, s=statistical significance; c=clinical significance

Clinical Practice Guidelines/Clinical Expertise/Patient and Family Preferences and Values

❖ **Clinical Practice Guideline:**

- The American Society of Regional Anesthesia and Pain Medicine (ASRA)
- Evidence Level IV and Quality grade A.

❖ **Clinical expertise:**

- Anesthesia providers/attending anesthesiologist(s)

❖ **Patient and Family Preferences and Values:**

- Safe healthcare that does not harm patients
- Patient-centered healthcare that is focused on patient preferences and values
- Efficient health care that is free of waste

Recommendations for Practice Based on the Evidence

- ❖ Literature search, internal data, clinical expertise, and patient preferences together constitute strong evidence:
 - That healthcare providers generally lack knowledge about LAST prevention, recognition, and treatment.
 - That interventions aimed at healthcare providers can improve this knowledge.
- ❖ The evidence supports development and implementation of a LAST education module aimed at improving healthcare providers' knowledge of LAST prevention, recognition, and treatment.

Theoretical Model

Steven's Star Model

- Discovery
- Evidence
- Translation to Guidelines
- Practice Integration
- Process and Outcome Evaluation

Model Fit

- Concise and clear
- Stakeholder incorporation
- Combines literature and clinical expertise
- Focus on outcome evaluation

Stevens Star Model of Knowledge Transformation

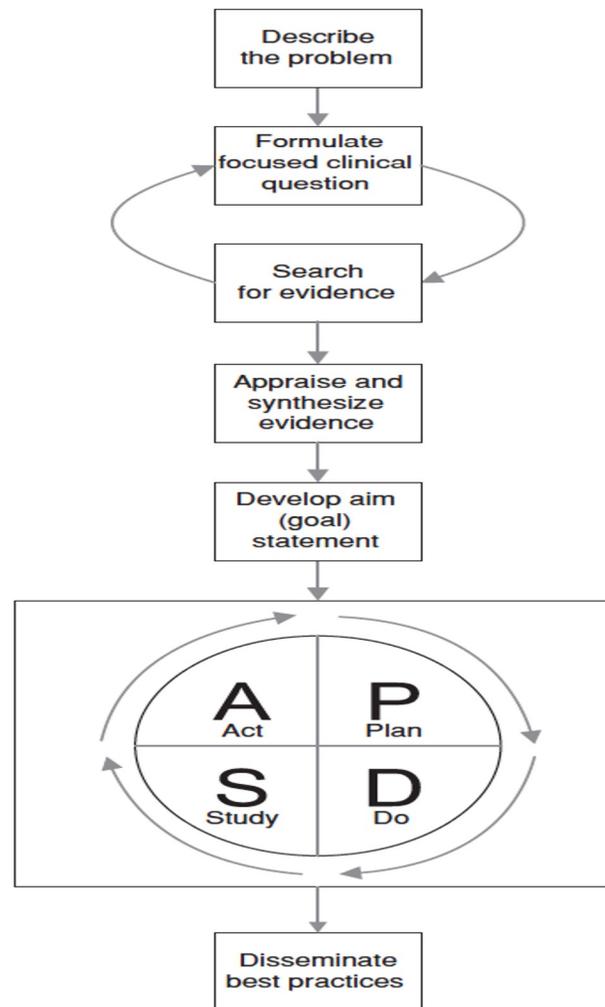
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(Stevens, 2013)

Project Design

- PDSA cycle



(Levin et al., 2010)

Implementation: Where and Who

- **Setting: Level I Trauma Center in Tennessee**
 - 37 operating rooms, cath lab, endovascular suite, GI lab, MRI, IR
- **Population: CRNAs at Project Site**
 - 84 CRNAs and 33 SRNAs
- **Stakeholders**
 - Surgery patients
 - Anesthesia Department
 - Administration
 - DNP Project Committee
- **Team**
 - 4 SRNAs
 - Project Chair
 - Community member

Implementation: SWOT Analysis

INTERNAL FACTORS	
<p>STRENGTHS (+)</p> <ul style="list-style-type: none"> Comprehensive stroke center Level I trauma center Magnet facility 1,550 patients per month receiving surgical services Support from anesthesia, pharmacy, neurological critical care, and stroke-team Robust system in place for implementing projects and anesthesia research specialists to assist in development and implementation 	<p>WEAKNESSES (-)</p> <ul style="list-style-type: none"> Potential for change fatigue: project site is very progressive with frequent new initiatives and change projects Project site is a teaching facility with numerous residents, students, and interns from many different organizations makes widespread education and protocol implementation challenging. Staff education on a large scale would potentially involve overtime and additional pay for employees who are already working full-time hours, increasing cost to the hospital and stress on the staff.
EXTERNAL FACTORS	
<p>OPPORTUNITIES (+)</p> <ul style="list-style-type: none"> Large body of evidence on preliminary search for LAST related information The American Society of Regional Anesthesia and Pain Medicine (ASRA) has a protocol available for download and modification on their website which is kept up-to-date with current evidence The project could potentially assist with the accreditation process of other services, such as stroke center accreditation, possibly increasing the size of the team conducting the project as well as potential funding. 	<p>THREATS (-)</p> <ul style="list-style-type: none"> LAST events may be considered an adverse event affecting reimbursement COVID 19 pandemic affecting multiple aspects including staffing at the project site, availability of onsite interaction during project development and implementation, etc. <p>(Jessee, 2021; Rubin et al., 2017)</p>

Implementation: Barriers and Facilitators

Barriers

- Resources: Consistently heavy workload of anesthesia providers
- Finances: Cost of training
- Competing interest of Stroke Team
- Time: limited time frame to complete project

Facilitators

- Project site culture
- Comprehensive stroke center certification
- Project site attitudes

Implementation: The Details

- Scope: PowerPoint education module
 - Pharmacological principles of LAs, safe dosing, interpersonal communication, LAST treatment
- Evaluation: Pre- and post-survey
- Budget : zero dollars

Methods of Evaluation

- **Data collection**
 - Chart review
 - Pre- and post-surveys
- **Data evaluation**
 - Worked with the university statistician to assess data from chart review and surveys
 - Improvement between pre- and post-survey indicated effectiveness

Findings



Findings- Outcome Measures

Variable Name	Variable Code	Variable Description	Data Source	Possible Range of Values	Level of Measurement	Time Frame for Collection
Provider Role	PR	Self-reported healthcare provider role/licensure level.	Survey	1= RN 2= NP 3= CRNA 4= PA 5= MD/DO	Ordinal	Before and after education module.
I am knowledgeable about the symptoms of LAST.	KSL	Question included in the pre and post survey that evaluates participants' self-perceived knowledge of the symptoms of LAST.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	Before and after education module.
I am comfortable screening patients for possible LAST.	CSL	Question included in the pre and post survey that evaluates participants' self-perceived comfort in screening for and identifying LAST.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	Before and after education module.
I am knowledgeable about the treatment of LAST.	KTL	Question included in the pre and post survey that evaluates participants' self-perceived knowledge of the treatment of LAST.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	Before and after education module.
I am knowledgeable about the risk factors for LAST.	KRFL	Question included in the pre and post survey that evaluates participants' self-perceived knowledge of the risk factors for LAST.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	Before and after education module.
This educational module increased my knowledge of LAST and how to treat it.*	EMI	Question included in the post survey that evaluates participants' self-perceived knowledge improvement after completion of the educational module.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	After education module.
I would like further information about LAST and how to treat it.*	FI	Question included in the post survey that evaluates participants' desire for further education about the topic.	Survey	1 = Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree	Ordinal	After education module.

Findings Cont... (Education Module)

Pre-Post Question Pairs	One-Sided T-Test(<i>p</i>) (<i>n</i> =22)	Two-Sided T-Test(<i>p</i>) (<i>n</i> =22)	Significance
Pre/Post: I am knowledgeable about the signs and symptoms of LAST	<.001	.002	Statistically Significant
Pre/Post: I am comfortable screening a patient for possible LAST	<.001	<.001	Statistically Significant
Pre/Post: I am knowledgeable about the treatment of LAST	.010	.020	Statistically Significant
Pre/Post: I am knowledgeable about the risk factors for LAST	<.001	<.001	Statistically Significant

Findings Cont... (Education Module)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
This education module increased my knowledge of LAST and how to treat it	16	1	5	4.63	1.025
I would like further education topics presented about LAST and how to treat it	16	1	5	4.00	1.265

Findings Cont... (Education Module)

Group	N=	Percent	Valid Percent	Cumulative Percent
CRNA	16	66.7	72.7	72.7
Resident	6	25	27.3	100
Provider Total	22	91.7	100	-
Missing Results	6	8.3	-	-
Cumulative Total	24	100	-	-

Findings Cont... (Chart Review)

	Inpatient	ED
Total Code Stroke Calls	101	860
Charts NOT meeting selection criteria	90	750
Charts pulled for initial review based on initial selection criteria	13	110
Charts found with excessive local anesthetic administration	3	0

Findings Cont... (Chart Review)

Patient	Max Allowance	Local Dosage	Max% Dosage	Overage
1	Lidocaine=300mg Bupivacaine=175mg Ropivacaine=225mg	Lidocaine=60mg Bupivacaine= 10mg Ropivacaine=150mg	Lidocaine=20%% Bupivacaine=7.35% Ropivacaine=73.5% Total: 100.85%	+0.85%
2	Lidocaine=300mg Exparel=266mg Ropivacaine=216mg	Lidocaine=60mg Exparel= 266mg Ropivacaine=100mg	Lidocaine=20% Exparel=100% Ropivacaine=46.3% Total: 166.3%	+66.3%
3	Lidocaine=220mg (49kg) Ropivacaine=147mg (49kg)	Lidocaine=60mg Ropivacaine=150mg	Lidocaine=27.2%% Ropivacaine=102% Total: 129.2%	+29.2%

Implications



Implication for Practice/Policy Change

Strengths of the project

- Access to internal data and detailed review of the Code Stroke Alert charts demonstrated evidence that patients at the project site are occasionally receiving unsafe doses of local anesthetics, and this could be leading to undiagnosed incidence of LAST that are being misidentified as Code Strokes.

Limitations of the project

- Time limitations for completion of this project restricted a second chart review.
- Small sample size (n=16) compared to size of department

Impact of our educational module signified that:

- There is a knowledge gap about LAST among the providers on a local level.
- Providers are open to and need more education on LAST.
- Educational module does measurably improve provider knowledge of LAST.

Project Implication

- All providers at the project site who are involved with patients who receive local anesthetics should receive baseline education on LAST prevention, recognition, and treatment, to improve outcomes and deliver a higher quality care to patients and families at the project site.

Dissemination Plan

- DNP Project Defense Presentation to Stakeholders
- Upload Digital Education Module and defense video to YouTube
- Submit an abstract of this paper to the Tennessee Research and Creative Exchange (TRACE)

Ethical Considerations and Sustainability

- Ethical considerations
 - IRB review: Exemption
 - Chart Review: De-identification
 - Surveys for education tool: de-identification
- Sustainability
 - Educational module is easily disseminated to other providers at the project site as needed
 - Updates can be made as new information becomes available
 - Future DNP projects plan to continue our work
 - Future chart reviews can be compared to our chart review to determine if rates of LAST at the project site are decreasing

(Carter et al., 2017)

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