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Best Practice

Resuming Breastfeeding After Surgery: Influencing Practice Recommendations

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A B S T R A C T

Purpose: Mothers often request guidance on when it is safe to resume breastfeeding after surgery. At our institution, this guidance was inconsistent and not well-grounded in current research. This project sought to bring recommendations to patients in line with current evidence about when to recommend resumption of breastfeeding after surgery.
Design: A local practice guideline was developed based on our systematic review, then staff were educated about the guideline.
Methods: Transfer to clinical practice was measured by reported practice recommendations. A repeated measures design measured change in provider knowledge, recommendations, and confidence in these recommendations. A follow-up assessment was conducted at 2 years to measure long-term impact.
Findings: After the educational session, there was a two-fold increase in the number of perianesthesia staff who recommended resumption of breastfeeding as soon as the mother had recovered from anesthesia.
Conclusions: This evidence-based practice project standardized delivery of breastfeeding recommendations by perioperative staff.

Exclusive breastfeeding is very important for promoting the overall health of infants,[1] but when mothers have surgery, breastfeeding may be interrupted or stopped completely.[2] Perioperative nurses at our facility deliver the majority of face-to-face, presurgical and postsurgical patient education. These nurses are ideally positioned to provide the patient with evidence-based guidance on the resumption of breastfeeding after a surgical procedure. When a mother asks her nurse whether it is safe to resume breastfeeding after surgery, the response should be clear, consistent, and evidence-based. Interviews with staff at our mid-sized military hospital identified divergent views on when breastfeeding should resume, prompting the project team to evaluate available evidence for transfer of common anesthetic medications into breastmilk. This team of 3 graduate nursing students and 2 nurse anesthesia faculty translated this evidence into practice by developing a local practice

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guideline and then teaching staff to use that guideline to educate patients about the resumption of breastfeeding after surgery.

Evidence Synthesis

A search for the most recent evidence related to the transference of commonly used anesthetic medications into mother's milk was conducted using PubMed, CINAHL, and Embase. The search of each database used the keywords “breastfeeding”, “breast milk”, “breast fed”, “colostrum”, or “lactation” combined with names of each of the perioperative medications listed in the following sentences. Detection capacity for medications has changed as technology has evolved. The literature search included articles published in English, between January 1, 1970, and January 1, 2020 (2017 when executing the original project). The earliest inclusive date of 1970 was selected to coincide with the development of the first valid technology for quantifying medication levels in breast milk, liquid chromatography with mass spectroscopy.[3,4] Intravenous medications commonly used in the intraoperative setting within the Military Health System were considered: propofol, etomidate, ketamine, fentanyl, sufentanil, alfentanil, remifentanil, morphine, hydromorphone, midazolam, sevoflurane, isoflurane, desflurane, rocuronium, vecuronium, succinylcholine, neostigmine, sugammadex, edrophonium, atropine, and glycopyrrolate.

The Johns Hopkins Nursing Evidence-Based Practice Model Evidence Level and Quality Guide[5] was used to rate the level of evidence each source. Sources written in English describing medication detection in breast milk or colostrum or their effect on the breastfed infant; protocols endorsed by professional organizations; and strength of evidence levels I-IV were considered for inclusion. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), the project team performed a systematic review of the literature. The aforementioned search terms yielded 8,309 initial sources, duplicates were removed, then titles and abstracts were screened for relevance. The remaining 119 sources were further evaluated, and after applying inclusion and exclusion criteria upon full-text review, 17 articles remained eligible for evidence appraisal. The PRISMA process for screening and extraction is displayed in Figure 1. A minimum of two reviewers independently rated each full-text source.

The majority of the sources were rated level II with an A or B quality rating (A = 7, B = 9) (Table 1). Findings were largely consistent with prior reviews supporting the safety of resuming breastfeeding after recovery from anesthesia.[6,7] LactMed is a publicly accessible, peer-reviewed database from the National Library of Medicine which describes known transfer of medication from breastfeeding mothers to their infants.[8] Where sources did not adequately describe transference into breast milk for a particular medication or class of medication, expert consensus from Cobb et al[6] or the LactMed database[8] was recorded and used to inform the local practice recommendations.

The breastfed infant is likely to receive less than 3.5% of a weight-adjusted therapeutic dose.[9] As many medications administered to patients under anesthesia are lipophilic, they often have a wide therapeutic index and rapid offset.[10,11] Medications move out of the blood to their respective fluid compartments depending on this fat solubility, away from breastmilk production in the mother. Once the infant receives the greatly reduced concentration of medication by breastfeeding, their own liver metabolism further degrades it. Even water-soluble medications such as morphine demonstrate limited passage into breastmilk and an almost imperceptible effect on infant behavior.[12,13] These factors often prevent a therapeutic effect in healthy breastfeeding infants.[9]

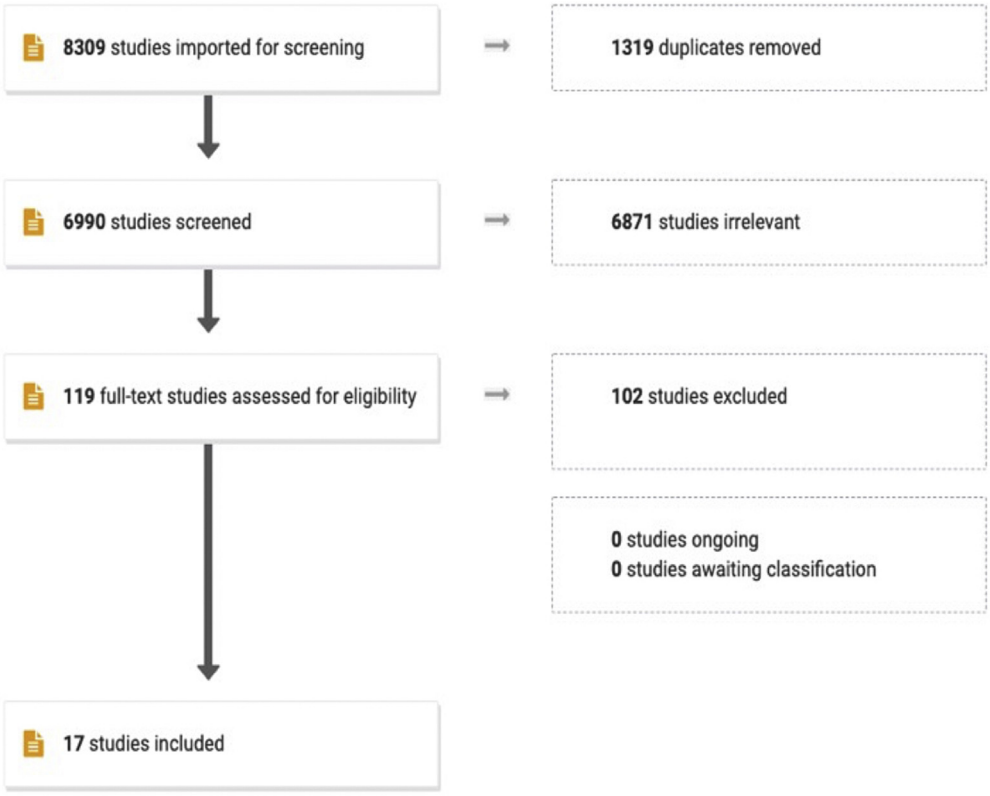

Figure 1. Flowchart of literature review process. This figure is available in color online at www.jopan.org.

Table 1
Synthesis of Evidence for Medication Transfer Into Breastmilk

First Author, Year	Medication	Levels (Mean) (B) Breastmilk, (MS) Maternal Serum, (IS) Infant Serum	Level; Quality
Baka, 2001	Morphine	(B) 34, 24, 7, 6.5, & 2.1 ng/ml at 0, 12, 24, 36, & 48 hrs	II; B
Cobb, 2015	Multiple	N/A, (protocol/recommendation)	IV; B
Cohen, 2009	Fentanyl	(B) 6.4 ng/ml in breastmilk, (IS) negative after 24 hr	II; C
Dailland, 1989	Propofol	(B) 0.17 & 0.14 mcg/ml at 4 & 8 hrs (B) 0.54, 0.036, 0.048 at 4, 6, & 8 hrs	II; A
Edwards, 2003	Hydro-morphone	(B) Weight adjusted dose <1% of maternal dose over 24 hrs.	II; A
Esener, 1992	Etomidate	(B) 79.3, 16.2, & 0 ng/ml at 30 min, 2 & 4 hrs	II; A
Feilberg, 1989	Morphine	(B) Peak of 500 ng; 50 mcg per 100 ml, equivalent IV dose 10-20 mcg	II; B
Giesecke, 1985	Alfentanil	(B) Alfentanil: 4 hrs, 0.88 ng/ml. 28 hrs, 0.05 ng/ml	II; B
Leuschen, 1990	Fentanyl	(B) Fentanyl: 4 hrs (<0.05-0.14 ng/ml). Value of 0.09 ng/ml	II; B
Koitabashi, 1997	Midazolam	(B) at 0.5, 1, 2, 4, 6, & 24 hrs. Range <5 - 25 ng/ml	II; B
Madej, 1987	Sufentanil Fentanyl	(B) Undetectable after 5 hrs.	I; A
Matheson, 1990	Midazolam	(B) Undetectable after 7 hrs, 15 mg maternal oral dose.	II; A
Montgomery, 2012	Multiple	N/A (protocol/recommendation)	IV; B
Nitsun, 2006	Propofol fentanyl Midazolam	(B) Propofol, 26 mcg in 24 hrs Fentanyl, 24 ng in 24 hrs Midazolam, 80 ng in 24 hrs	II; B
Steer, 1992	Fentanyl	(B) 40, 0.22, 0.15, 0.05, 0.07, & 0.05 ng/ml at 45 min, 2, 4, 6, 8, & 10 hrs	II; A
Stuttmann, 2010	Propofol	(B) 2.78, 0.13 & 0.84 mg/l at 0, 1.5, & 5 hrs	II; B
Wittels, 1990	Morphine	(B) 50, 60, 50, 60, 25, & 20 ng/ml, at 12, 24, 36, 48, 72, & 96 hrs. No effect on infant behavior.	II; A

Further considerations exist for younger infants and neonates who have immature hepatic metabolism, fat uptake, and preferential protein binding. These contributing factors will approach adult values as the infant nears 6 months of age.[14-16]

Practice Recommendation 1: Support the Mother in Breastfeeding as Soon as She has Recovered from the Immediate Effects of Anesthesia

As detailed previously, transfer into breastmilk is negligible when medications are given in usual doses for anesthesia. Considerations include the provision of physical safety for the breastfeeding infant in the postoperative setting. Mothers who are not alert are not likely to safely hold their infants while breastfeeding. Waiting for the psychotropic effects of anesthesia to decline also allows for additional elimination time, which may ultimately reduce medication transfer to the infant.

Practice Recommendation 2: Empower the Mother to Make an Informed Choice About When to Breastfeed Her Infant After Surgery

While under the effects of anesthesia, patients can be expected to be unaware of the medications given or their implications. Patient teaching should begin in the preoperative phase to maximize postoperative understanding and satisfaction regarding these instructions.[17] Patient teaching is most often the role of the nurse caring for the patient in the postoperative setting, but perioperative nurses who interview patients before surgery have an increasingly important role in this endeavor.[17,18] We provided a brochure where anesthesia or nursing staff could write down medications given to breastfeeding mothers intraoperatively, then is given to the mother with their discharge instructions.

Practice Recommendation 3: Consult the LactMed Database for Medications, Conditions, or Situations not Otherwise Addressed

Premature infants, infants with organ dysfunction, or those with chronic disease may have unique metabolic or physiologic derangements that could interfere with the plan to breastfeed immediately after surgery. The effect of continuous infusion or frequent repeat dosing on transfer into breastmilk is unclear, so caution is advised in these cases. Studies that directly measure medication or metabolite transfer into breastmilk are infrequent, and for many medications, such measurements have never been described. The LactMed database is a useful tool for incorporating existing knowledge about medication transfer and applying it in the context of its molecular size and pharmacokinetics. This database is available at https://www.ncbi.nlm.nih.gov/books/NBK501922/and is compatible with mobile phone platforms.[8] LactMed is not written in layperson's language, so the team recommends that nurses help their patients interpret findings from this resource.

Model

Organizing Framework

The Iowa Model[19] guided the project from conception to implementation and sustainment. The team conducted interviews with staff stakeholders and hospital leadership to identify the problem of inconsistent recommendations for breastfeeding mothers after surgery. After problem identification, the team conducted the systematic search as described previously, then used the findings to build an educational presentation. The presentation was chosen as the initial mechanism to deliver knowledge that would facilitate change. According to the Theory of Planned Behavior,[20] knowledge acquisition is expected to modify individual practices.[21] The presentation was piloted to experienced critical care nurses enrolled as graduate nursing students, then the project moved beyond the pilot phase when presented to staff. Mechanisms for sustainment and evaluation of sustainment efforts were also planned initially and implemented over the 2 years of the project's scope.

Project Aims

This project's primary goal was to develop and share evidence-based practice recommendations that would result in a reduced variance of staff recommendations for resumption of breastfeeding after surgery. Second, the team sought to validate that delivery of the training was effective through knowledge assessment. Another secondary goal was to describe observations regarding the efficacy

of an enduring practice manual entry and biennial training schedule to sustain these recommendations.

Methods

Context

The project was conducted at a military hospital performing up to 6,000 surgical cases annually, many of whom are mothers of childbearing age. Integral partnerships were made with preoperative and postoperative nursing teams and their respective training officers. The anesthesia department and postoperative care unit were included as participants in this educational intervention deemed exempt by an institutional review board designee.

Practice Change

The practice recommendations and associated findings of the literature review were presented in lecture format to anesthesia and perianesthesia staff, summarized in Table 1. An anonymized questionnaire was distributed at three time points: before training, immediately after training, and delayed after training at 2 years. The primary outcome measures for this assessment were a change in individual practice habits and change in confidence when making those recommendations. As all educational presentations are expected to result in some knowledge transfer, change in knowledge was only considered a secondary outcome. This measure was used to validate that knowledge transfer occurred as expected.

Demographic questions evaluated prior experience with breastfeeding patients in the perioperative setting and awareness of sources of evidence to inform perioperative recommendations given to breastfeeding mothers. Eight questions assessed knowledge of the presentation content. The final two questions solicited their recommendations to breastfeeding mothers at the time of surgery and belief that the given recommendation was grounded in evidence. The second assessment consisted of only 10 questions regarding knowledge and confidence. The knowledge and confidence assessment was readministered 2 years later. Approximately two-third of military staff transfer every 2 years, so a repeated measures analysis on the same participants was not possible; however, it was used to inform leadership on the need for periodic retraining.

Departmental Policy

The project team developed policies for the anesthesia department and postoperative care unit to serve as an enduring resource to perpetuate a consistent message to breastfeeding mothers. The

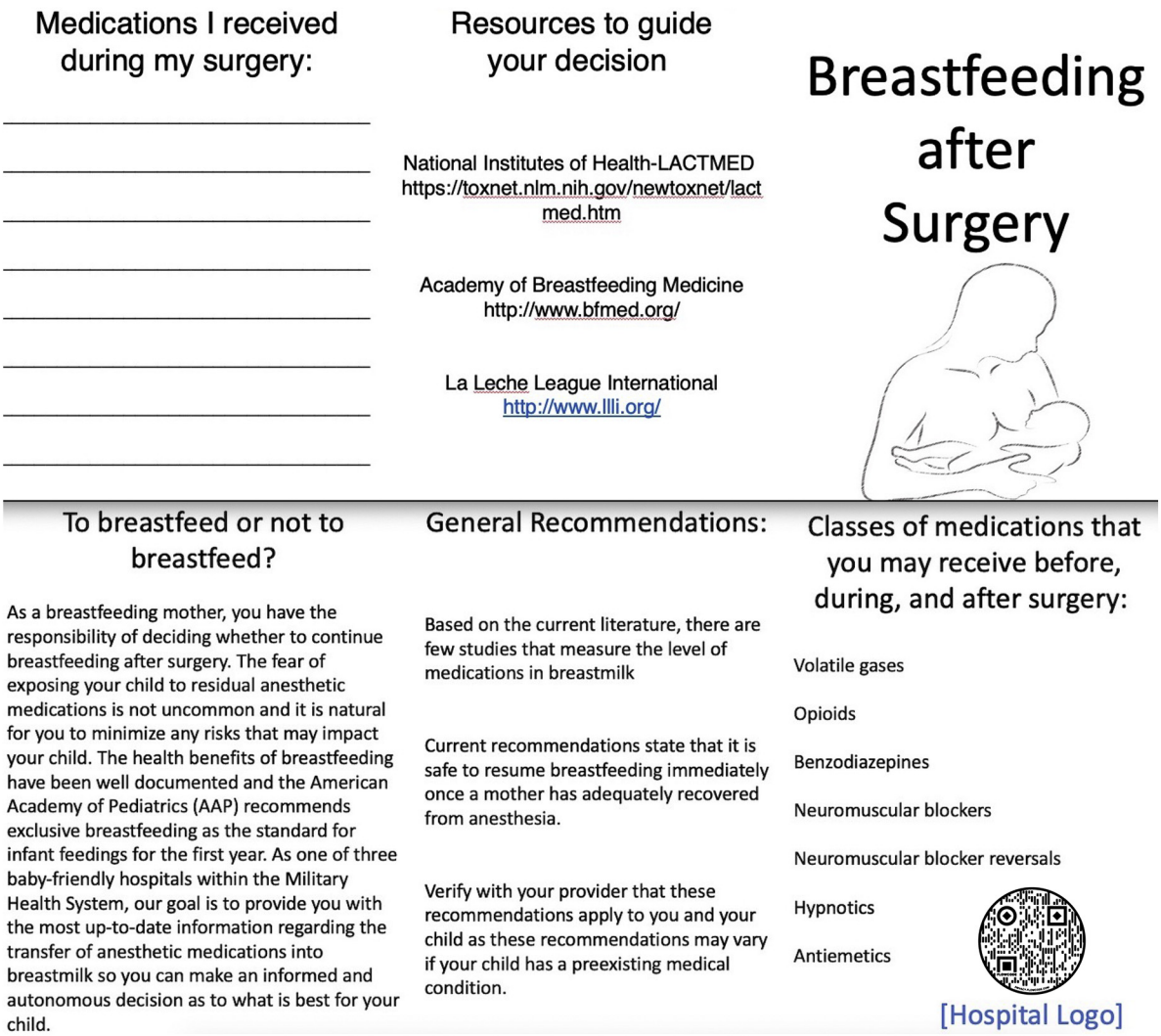

Figure 2. Breastfeeding brochure. The Q-R code links the reader to a sample file of the brochure.

content of this policy mirrored the recommendations mentioned previously for both physicians and nurses, and no such policy had already been in place. New staff are required to review the content upon arrival.

Patient Brochure

The project team developed a brochure for breastfeeding mothers that provides information regarding the safety of breastfeeding after anesthesia (Figure 2). The brochure was intended to communicate that the hospital and its staff care about helping mothers decide when to resume breastfeeding. It also provides a space where staff write in specific drugs administered. This brochure was considered optional for nurses to use when patients had related questions.

Analysis

All data were entered into Statistical Package for the Social Science (SPSS) version 24 and assessed for accuracy, missingness, and normality. Responses to knowledge assessment questions were scored as "correct" or "incorrect." Missing responses were coded as "incorrect." The number of correct responses was summed to arrive at a total score ranging from 0 to 8. Owing to the small sample size, medians (interquartile range [IQR]) and frequencies were calculated to describe the centrality and dispersion of variables. McNemar's test and the Wilcoxon signed-rank test were used to compare immediate preimplementation and postimplementation responses for categorical and ordinal information, respectively. The Chi-square test was used to assess for demographic differences between cohorts, 2017 versus 2019, and differences in recommendations made to patients and confidence in those recommendations across knowledge assessment administrations across the three time points: before training, immediately after training, and delayed after training. The Kruskal-Wallis test was used to assess for omnibus differences across all administrations, with a post-hoc Mann-Whitney U test used to assess for between-administration differences if the omnibus test was significant. α Was 0.05 (two-tailed) for all tests, and no adjustments were made for multiple hypothesis tests given the exploratory nature of the project.

Results

Sample demographics are depicted in Table 2. Ten participants completed training in 2017, including the pretests and posttests, and eleven participants completed the follow-up assessment in 2019. Most participants in both cohorts were anesthesia providers (2017, n = 7; 2019, n = 10), reported encountering breastfeeding women weekly or monthly (2017, n = 8; 2019, n = 7), and identified either "Primary Training" or "Literature" as the source of recommendations given to their patients (2017, n = 8; 2019, n = 10). The proportion of participants who were correctly informed about the status of the departmental breastfeeding policy improved from 2017 to 2019. In 2017, only two participants were aware that the department did not have a policy, while in 2019, seven participants were aware of the departmental policy implemented in 2017 ($\chi 2 = 4.07$; $P = .04$). No significant differences were noted between cohorts with respect to experience, professional resources engaged to answer questions about breastfeeding, or awareness of additional resources.

Pretraining, posttraining, and delayed reassessment scores are depicted in Figures 3-5. Before training, the median knowledge score was 4 (IQR = 2.25); however, after the training, the median score increased to 6 (IQR = 2.25). This improvement in scores was statistically significant (N = 10, Wilcoxon signed-rank test Z = 2.26, $P = .024$). After training, the number of staff who recommended resuming breastfeeding immediately increased from n = 7 to n = 10; however, this difference was not statistically significant (McNemar test; $P = .24$). Self-reported confidence in ability to give evidence-based recommendations to breastfeeding mothers increased from a median of 2/4 (IQR, 2; representing a response of "somewhat confident") to a median of 3/4 (IQR, 1; representing a response of "confident"). This increase was statistically significant (N = 10, Wilcoxon signed-rank test Z = 2.43, $P = .015$).

In 2019, the median number of correct answers on the knowledge assessment was 4 (IQR, 4), and median confidence was 3 (IQR, 1). The number of questions correctly answered was stochastically different across iterations (df = 2; Kruskal-Wallis H Test = 9.80; $P = .007$), with immediately posttraining scores higher than either pretraining (Mann-Whitney U Test = 12.5; $P = .003$) or delayed posttraining scores (Mann-Whitney U Test = 20.5; $P = .013$). Pretraining scores were not significantly different from delayed posttraining scores (Mann-Whitney U Test = 48.5; $P = .654$). There were no significant differences across all three administrations in either the recommendations participants would make to patients ($\chi 2 = 8.5$, $P = .204$) or their confidence in those recommendations (Kruskal-Wallis H Test = 5.75; $P = .056$).

Table 2
Demographic and Resource Information

Variable	Cohort		Test of Difference	
	2017 (n = 10)	2019 (n = 11)	$\chi 2$ Value	Probability
Profession			3.94	.322
MDA	3	2		
CRNA	4	8		
RN	2	0		
Other	1	1		
Anesthesia experience (y)			5.47	.141
0-5	6	3		
6-10	3	5		
>10	0	3		
N/A	1	0		
BF knowledge source			1.36	.716
Primary training	4	6		
Peer recommendation	1	1		
Literature	4	4		
Other	1	0		
Knowledge about BF policy			4.07	.044
Correct	2	7		
Incorrect	8	4		
Frequency of encounter?			6.07	.193
Daily	2	0		
Weekly	3	3		
Monthly	5	4		
Yearly	0	3		
Rarely	0	1		
Resources used			1.97	.742
OB/GYN	3	2		
Anesthesia	2	4		
Pharmacy	1	1		
Lactation specialist	4	3		
Multiple	0	1		
Awareness of additional resources			1.18	.555
Yes	8	10		
No	1	1		
Don't know	1	0		

BF, breastfeeding; CRNA, Certified Registered Nurse Anesthetist; MDA, Medical Doctor (Anesthesiology); N/A, not applicable; OB/GYN, obstetrics or gynecology provider, inclusive of both physicians and midwives; RN, registered nurse.

Discussion

This project improved perianesthesia staff knowledge about recommendations to lactating mothers after surgery, but the

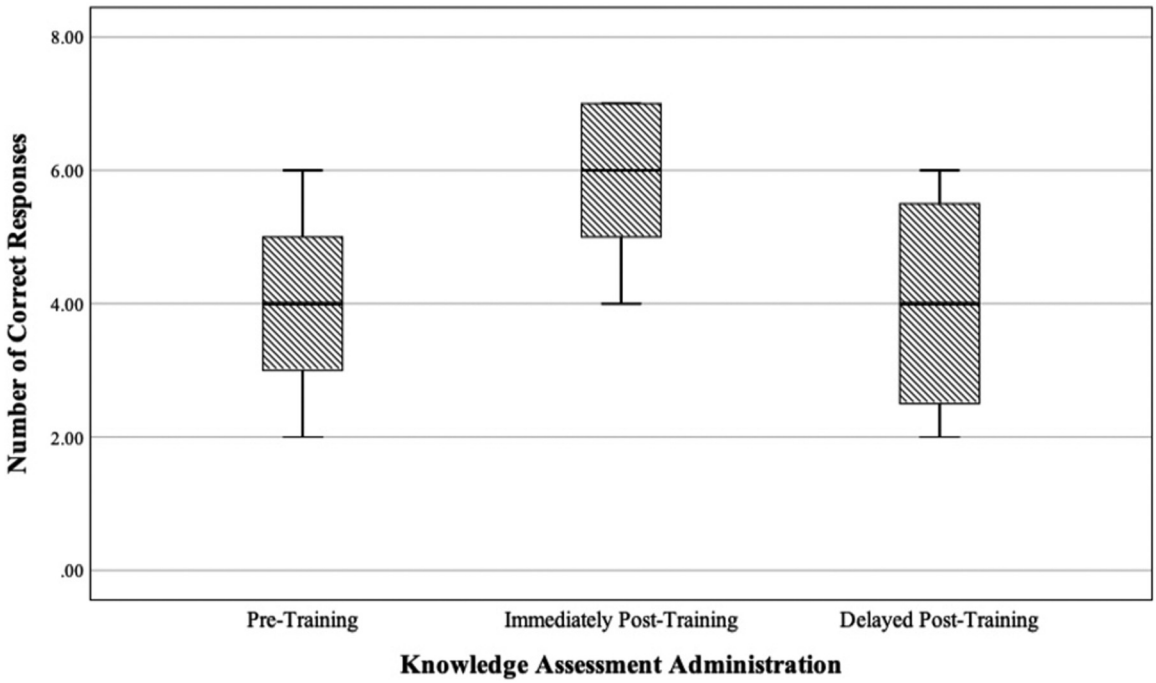

Figure 3. Knowledge assessment across cohorts.

changes in knowledge were not sustained after 2 years. Staff reported turning to lactation specialists, obstetric physicians, or even other anesthesia providers for related information. Once staff were given the most current information, all of them reported a willingness to recommend that breastfeeding can resume as soon as the mother is able to do so after surgery and reported greater confidence in providing that recommendation. These improvements were difficult to sustain over a 2-year period with only static policy guidance. The 2-year staff reassessment showed that staff retain the knowledge of the overall recommendation to breastfeed immediately after recovery; however, they do not retain the detailed knowledge guiding those recommendations.

Future Directions for Practice and Research

The evidence synthesis for this project highlighted the relative absence of research measuring transference of common anesthetic drugs through breast milk and the effects these drugs have on breastfeeding infants. An additional research topic would be the learning needs of mothers undergoing surgery and the best modalities to meet those needs. For example, the brochure was

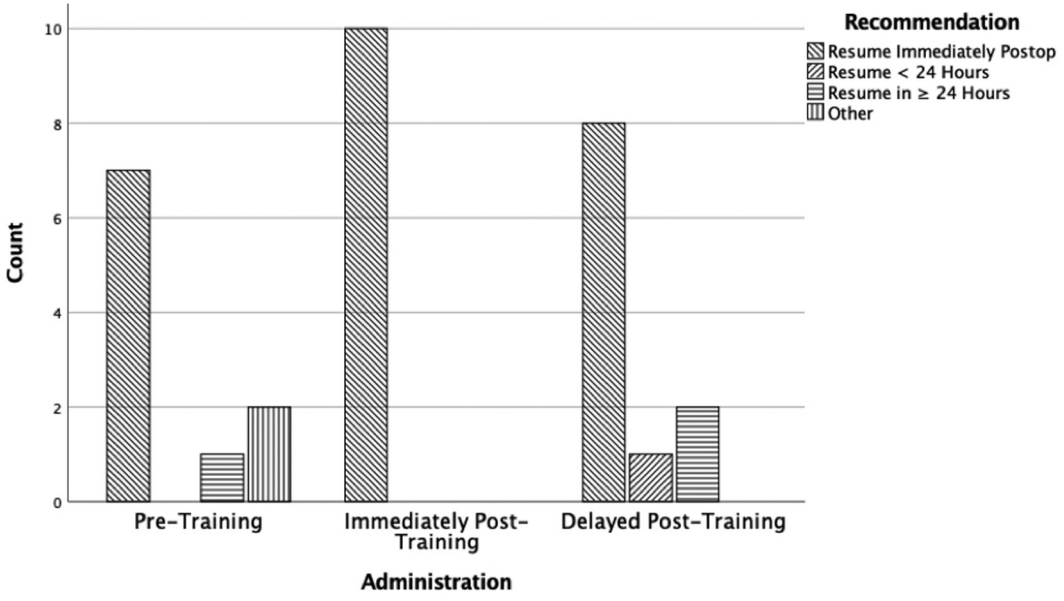

Figure 4. Recommendation to resume breastfeeding.

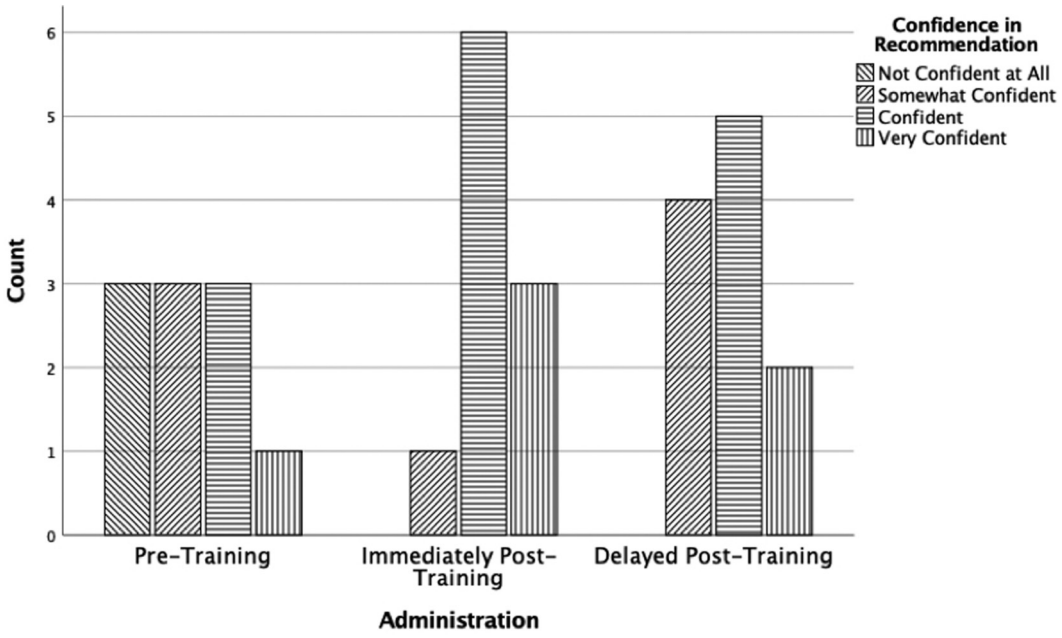

Figure 5. Confidence in recommendation to resume breastfeeding.

considered optional in this project because in the preoperative setting, medication leaflets have been perceived as providing too much information without having any effect on anxiety or satisfaction.[22] It is unclear whether breastfeeding mothers would find this information helpful as an adjunct strategy to reduce perioperative anxiety, and it warrants future study. Other patient-centered markers may be of interest for future projects for projects with a high volume of breastfeeding mothers. These markers were not considered feasible in our institution and relatively few nurses could be included because of the small number of our perioperative staff. For example, patient satisfaction metrics were not separately measured for breastfeeding mothers. A site caring for more breastfeeding mothers could examine such outcomes as the impact on patient satisfaction and postdischarge behavior, as well as the effectiveness of the intervention within a larger group of nurses. The training interval required to maintain knowledge behind such recommendations given to lactating mothers also warrants further study. Inclusion of other common perioperative medications such as local anesthetics could be a focus for future projects, but the authors felt that with varied routes of administration, onset, and admixtures, local anesthetics were beyond the scope of this project.

Limitations

Important limitations to this analysis include the small sample size, the inability to link multiple assessments to particular subjects across cohorts, and the nonadjustment of the α level for multiple assessments. The small sample size is an unavoidable result of performing the project at a community hospital; for example, the total anesthesia department contains only 13 providers, 55% to 77% of whom participated in one or both iterations of the project. Given the nature of military staff turnover, there is no way to follow and repeatedly reassess knowledge and practice habits for specific provider level year-to-year. This evidence-based practice project is not intended to produce generalizable results, rather it describes the impact of an educational intervention at one institution. The methods used to execute this project could, with appropriate site-specific changes, be replicated at other facilities interested in improving continuity of breastfeeding after surgery.

Conclusions

The implementation of an evidence-based educational tool led to a significant increase in provider knowledge and confidence in the delivery of postoperative breastfeeding recommendations in the immediate posteducation period. Our project shows that providers are willing to change their practice and alter their recommendations if the evidence is presented in a manner that promotes change. Continuing education and training is vital to create a shared mental model between nurses and anesthesia providers that delivers a consistent message to resume breastfeeding after anesthesia.

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