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Perioperative Non-opioid Modalities (PNOM) Questionnaire Implementation and Validation of its Psychometric Properties

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Perioperative Non-opioid Modalities (PNOM) Questionnaire Implementation and Validation of its Psychometric Properties

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Abstract

Introduction: *The opioid epidemic and prescription opioid related deaths continue to grow in the US. Contributing factors to this epidemic include nonrestrictive opioid administration in the perioperative period. Though solutions to the epidemic has been discussed by anesthesia providers, there is no tool to quantiatively evaluate of their beliefs and practices for the perioperative management of pain. Over the past three years, there has been advancement in the science of nurse anesthesia on this front and in 2020 Tucker and Wong completed the development of a quantitative tool aimed at assessing CRNA beliefs and practices with regard to their use of non-opioid modalities for the treatment of perioperative pain, the Perioperative Non-opioid Modalities (PNOM) Questionnaire. Our study administered their innovative tool to a large sample of CRNAs practicing in the US and to performed factor analysis for further validation.* ***Materials and Methods:*** *This study utilized a cross-sectional research design, distributing the PNOM Questionnaire electronically to CRNAs practicing the US. Data was evaluated with exploratory factor analysis (EFA) as well descriptive statistics to evaluate current CRNA practice.* ***Results:*** *After adequate factorablility was established, EFA was conducted and revealed 10 factors or themes. Five factors were deemed reliable with cronbach's alpha ≥ .70. Three important factors had questionable reliability with cronbach's alpha ≥ .6, yet < .70 and are discussed. Overall, practicing CRNAs are favorable and knowledgeable regarding the use of non-opioid modalities for the treatment of perioperative pain, however they do demonstrate room for further and/or continued education. The results also demonstrated time constraints and organizational support as limiting factors for the use of non-opioid modalities perioperatively.* ***Conclusion:*** *The underlying constructs impacting beliefs and behaviors of opioid vs. non-opioid administration among CRNAs have significant impacts on non-opioid policy, practice and education.*

Keywords: CRNA, non-opioid analgesia, non-opioid, opioid sparing, perioperative analgesia

Introduction

Over the past few decades, the opioid epidemic has grown substantially---evolving into a national crisis--- stemming from opioid over-prescription and increasing opioid-related deaths. In only a span of a decade, opioid prescription in the United States alone increased by 104% from 43.8 to 89.2 million; there are also approximately 115 daily opioid-related deaths.[1-2] The opioid crisis is thought to originate from various factors including but not limited to healthcare provider over-prescribing, insufficient pain management education among healthcare providers, inadequate evidence-based acute pain management guidelines, illicit drug use, etc.[1,3] The perioperative period that surrounds surgery posits a unique and considerable contributing factor to the growing opioid crisis that predisposes patients to opioid dependence, irrespective of their type and acuity of surgery, opioid tolerance, comorbidities, etc.[2]

In an effort to achieve optimal intraoperative pain control and attenuate opioid administration by supplementing with non-opioid approaches, it is necessary to ascertain certified registered nurse anesthetists' (CRNA) perspectives and practices on a larger scale. The goal is to elucidate the prevalence of previously identified barriers and facilitators at the national level. Collectively, this data will inform how to best address possible shortcomings involved when incorporating non-opioid modalities into national policy and practice.

Currently, evidence-based protocols such as Enhanced Recovery After Surgery (ERAS) that are meant to guide healthcare providers in utilizing non-opioid approaches in an effort to minimize opioid use, are not widely adopted or consistently followed by all institutions that offer surgical services.[4] Thus, intraoperative non-opioid approaches are not standardized, and their use varies widely between institutions despite growing evidence of improved surgical outcomes and comparable analgesia effects with much less negative side effects.[3] The problem remains that even in institutions that implement such evidence-based protocols, CRNAs still identify barriers

to utilizing intraoperative non-opioid approaches despite the burgeoning opioid crisis and knowledge of possible long-term opioid complications from perioperative opioid administration. Moreover, it is not clear in the literature why such variance in intraoperative administration of non-opioid approaches exists among CRNAs.

As the opioid crisis continues to rise, anesthesia providers should consider minimizing opioid administration even beyond the intraoperative phase. In order to perform this endeavor, anesthesia providers must be conscious of the possible long-term detrimental effects patients inadvertently acquire from intraoperative opioid administration. This study will focus on CRNAs, also known as nurse anesthetists.

In the United States, CRNAs are the primary providers of anesthesia and account for nearly 70% anesthesia delivery in rural areas.[5] In many states, CRNAs can independently provide anesthesia without physician oversight. Even though CRNAs administer most of the anesthesia in the U.S., little research has been done to measure the barriers and facilitators of non-opioid approaches, specifically among CRNAs.

Research to date has described excessive use and over-prescription of opioids in the clinical setting. Many studies have been conducted that focus on the benefits of intraoperative non-opioid utilization, specific non-opioid pain management modalities, and on the opinions of intraoperative health care providers.[6-8] But to date, only a few studies exist that evaluate the needs of CRNAs in reducing intraoperative opioid use.[2]

The purpose of this study is to (1) administer the PNOM questionnaire to a large sample of CRNAs practicing in the US to quantitatively evaluate their beliefs and practices regarding their use of non-opioid modalities for the treatment of perioperative pain and to (2) perform

exploratory factor analysis (EFA) to help identify unified concepts and to prepare variables to be used for structural equation modeling.

Exploring CRNA facilitators and barriers to the use of non-opioid adjuvant analgesic agents

Before attempting to implement change by encouraging CRNAs on the use of intraoperative non-opioid approaches, the phenomenon behind the inconsistencies of its use must be investigated. One qualitative study examined and described CRNAs' perspectives and practices on administering opioids vs nonopioid or opioid-sparing strategies during the intraoperative period.[2] Velasco and colleagues interviewed 12 CRNAs who had at least three years of current working experience from three distinct practice settings with various levels of opioid-alternative resources and/or opioid alternative protocols within institutional policy. Interview data was analyzed and distinct themes emerged revealing common facilitators and barriers to CRNA use of intraoperative non-opioid alternatives. Velasco et al. identified six barriers and four facilitators. The six barriers included: opioid superiority, inconsistent analgesic effects of opioid alternatives, limited experience with opioid alternatives, limited opioid-alternative resources, negative experiences with intraoperative opioid-alternative administration, and patient comorbidities. Facilitators included adverse effects of opioids, institutional policy and procedures, positive experiences with opioid alternatives, and regional anesthesia superiority. This study identified possible future steps to assess the same information on a larger scale. However, no known validated tool exists to garner crucial data from a larger population that is necessary when making recommendations for national policy and practice.

Creating and validating a tool to assess CRNA use of perioperative non-opioid modalities

Utilizing the results from the Velasco study, Tucker and Wong[9] created and validated (on a small scale) an assessment tool designed to measure that barriers, moderators, and facilitators surrounding CRNA use of non-opioid modalities for the treatment of pain in the perioperative period. They created the Perioperative Non-Opioid Modalities (PNOM) questionnaire using an instrument development study design. The PNOM questionnaire consists of 39 items measured with a 7-point Likert-type scale. Face and content validity of the 39 items was verified by a panel of content experts. In a pilot study of 42 participants, the authors established internal consistency of all 39 PNOM items; calculated cronbach's alpha coefficient was 0.73. Test/retest methodology established sufficient reliability (r= 0.81).

The purpose of our study is to (1) administer the PNOM questionnaire to a large sample of CRNAs practicing in the US to quantitatively evaluate their beliefs and practices regarding their use of non-opioid modalities for the treatment of perioperative pain and to (2) perform exploratory factor analysis (EFA) to help identify unified concepts and to prepare variables to be used for structural equation modeling.

Materials and Methods

Design

This study utilized the instrument, the PNOM questionnaire, created and piloted by Tucker and Wong (permission for use granted by the authors) in an online, cross-sectional survey design.

Discussion of study methodology fit with research question

Instruments implementation is an appropriate fit for our proposed research because our objective is to evaluate its reliability and validity and examine the perspectives of CRNAs nationally.

Protection of human subjects

All researchers completed up-to-date CITI training modules and the project received IRB approval from DePaul University's Office of Research Services.

Sample

CRNA participants with at least one year of experience were recruited via the American Association of Nurse Anesthetists (AANA) listserv, Facebook CRNA forums, and convenience and snowball sampling. Our target sample size was 390 participants.

Materials

The PNOM questionnaire, a 39 item tool aimed at evaluating barriers and facilitators for CRNA use of perioperative non-opioid modalities for the treatment of perioperative pain, was sent to participants, as developed by Tucker and Wong, in an electronic survey format. An example items is "I believe that opioids provide better analgesia than non-opioid modalities". Available responses were on a 7-point Likert-type scale, ranging from 1 = "Strongly agree", 2 = "Agree", 3 = "Somewhat agree", 4 = "Neither agree or disagree", 5 = "Somewhat disagree", 6 = "Disagree", and 7 = "Strongly disagree".

Exploratory Factor Analysis (EFA)

Factorability of the 39 PNOM items was established with the Kaiser-Meyer-Olkin Measure of Sampling Adequacy, the Bartlett's Test of Sphericity, and communalities. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy indicates the proportion of variance in the variables that might be caused by underlying factors. High values (close to 1.0) indicate that a factor analysis may be useful; Low values (< 0.50) indicate little value in factor analysis. Bartlett's test of sphericity tests the hypothesis that your correlation matrix is an identity matrix, which would indicate that your variables are unrelated and therefore unsuitable for structure

detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data.[10] Initial communalities are, for correlation analyses, the proportion of variance accounted for in each variable by the rest of the variables. Extraction communalities are estimates of the variance in each variable accounted for by the factors in the factor solution. Small values indicate variables that do not fit well with the factor solution, and should possibly be dropped from the analysis. The extraction communalities for this solution are acceptable, although the lower values of Multiple lines and Calling card show that they don't fit as well as the others.[10]

Factor analysis was conducted for the purpose of data reduction and structure detection. Exploratory factor analysis was conducted with varimax rotation – a method that minimizes the number of variables that have high loadings on each factor. This method simplifies the interpretation of the factors.[10] Reliability analysis was performed on each factor indentified.

Results

Study Participants

A total of 527 CRNA participants were recruited. Initial data analysis revelated 452 fully completed surveys. Incomplete surveys were excluded from the final set of data for the exploratory factor analysis (EFA). An additional 7 participants were excluded from the sample size because they had less than one year of post-graduate clinical experience. The final number of study participants was 445.

Demographic data revealed participants were primarily white (white, n=407; Hispanic, n=16; Asian, n=16; black, n=6; mixed, n=7; Native American, n=1) females (female, n=370; male, n=83). Although most practicing CRNAs are females, the overwhelming female response

to the survey may be attributed to Facebook recruitment and participation bias.[11] Participants were primarily in the 30-40 age range (30-35 age range, n=164; 36-40 age range, n=134; 41-45 age range, n=85; 46-65 age range, n=29). Participants between the ages of 61-65 made up a small fraction of the surveyed population at 1.3%. Almost half of the participants (n=203) have been practicing anesthesia for 1-5 years (6-10 years, n=146; greater than 10 years, n=96). Most were employed fulltime (full time, n=396; part time, n=32; per diem, n=25). Participants indicated that they were employeed by a hospital (n=194), by a group (n=182), were independent contractors (n=53), or were employed by a government agency (n=13).

Factor Analysis

Factorability. The Kaiser-Meyer-Olkin measure of sampling adequacy was .87 and the Bartlett's test of sphericity was $\chi^2 = 6913.09$, $p < .001$ (Table 1. PNOM Questionnaire KMO and Bartlett's Test). PNOM item communalities was conducted with principle component analysis (Table 2. PNOM Item Communalities). All items were strong enough and indicated that they each shared common variance with other items. Considering the preliminary findings, all 39 items were included in the EFA.

EFA with varimax rotation was performed on the PNOM items. Factors with eigen values loaded at 1.000 or more were selected. This produced 10 components. The scree plot confirms the choice of 10 components, also called factors, (Figure 1. Scree Plot of PNOM Factors). When conducting reliability analysis, the 10th factor was found to have only one item associated with it. The 11th factor was brought into its place. See Table 3. PNOM Items by Factor with Cronbach's Alpha. Specific results of the factors with cronbach's alpha > .70 will be described, including factors 1, 2, 3, 6 and 11. Descriptive statistics of the reliable factors will

also be described. See Table 4. PNOM Questionnaire Descriptive Statistics by Factor for all factors.

Factor 1: Nonopioid Modalities, Positive Outcomes

Nonopioid modalities, positive outcomes originally had 9 survey items correlated with it. One item, question 11 – "I believe that using non-opioid modalities can lower the risk of opioid addiction" was removed. With the 8 items, internal reliability was confirmed (cronbach's alpha = .87). An example from this factor includes item 33 "Using non-opioid modalities allows for the reduction of the adverse effects of opioids". The common underlying theme in the questions above reveals the CRNA's knowledge and beliefs about the positive outcomes associated with nonopioid modalities.

CRNA participants largely "agreed" with the statements in this factor, with mean scores ranging from 1.83 to 3.33. Item 32, "I believe that patients prefer non-opioid modalities" scored a mean score of 3.33 and standard deviation of 1.24, indicating slight hesitancy for the CRNA to agree that patients prefer nonopioid modalities.

Factor 2: Nonopioid Modalities, Institutional Support

Nonopioid modalities, institutional support has two PNOM items associated with it. The two items included in this factor are item 12, "My institutional culture supports the use of non-opioid modalities" and item 13, "I have ample non-opioid modalities at my disposal". A third item was removed from this factor (item 10, "I use non-opioid modalities when they are available to me") as it was not thought to be a true assessment of institutional support, rather CRNA preference. Factor reliability was established (cronbach's alpha = .87). The two items in this factor asses institutional culture and resources.

CRNA participants generally “agreed” to the statements in factor 2 indicating positive institutional support for the use of nonopiod modalities. Mean score (standard deviation) for item 12 was 2.58 (1.59) and item 13 was 2.88 (1.73).

It is challenging to promote opioid-sparing techniques without having resources or support from one's organizational culture. In other words, all the stakeholders, such as the patients as the consumers, the clinicians who can prescribe (i.e., MDs, NPs, and PAs), and all other clinical staffers that provide patient education and care coordination at the frontline

Factor 3: Opioid, Positive Outcomes

Opioid, positive outcomes has 3 PNOM items associated with it. A sample item from this factor includes item 1, “I believe that opioids provide better analgesia than non-opioids modalities”. Factor reliability was established (cronbach’s alpha = .74). This factor assesses the CRNAs' belief systems as it pertains to traditional perioperative opioid administration.

CRNA participants generally “agreed” to “somewhat agreed” to the positive statements regarding perioperative opioids. However, item 1, “I believe that opioids provide better analgesia than non-opioids modalities” had a mean score of 3.94 with standard deviation of 1.42, indicating hesitancy on the part of the CRNA to commit to agree or disagree.

Factor 6: Regional Anesthesia, Time

Regional anesthesia, time has two PNOM items associated with it. Item 18, “The amount of time it takes to implement regional anesthesia influences my decision to use opioids” and item 19, “The amount of time it takes to implement regional anesthesia influences my decision to use non-opioid modalities” Reliability was established (cronbach’s alpha = .93).

CRNAs participants stayed relatively neutral on this factor scoring a mean score (standard deviation) of 4.68 (1.67) on item 18 and 4.61 (1.61) on item 19, leaning towards the "somewhat disagree" side of neutral with the statements.

Factor 11: Nonopioid Modialities, Limited Experience & Access

Nonopioid modalities, limited access and experience was associated with 2 PNOM items: Item 23, "I have limited experience with non-opioid modalities" and item 24, "I have a lack of non-opioid modalities at my disposal". Reliability was established (cronbach's alpha = .72). As stated, this factor assessed the CRNA's experience and access to perioperative nonopioid modalities.

CRNA participants indicated that experience and access to nonopioid modalities where not complete barriers. Tending to "somewhat disagree" with the stateements, CRNAs scored a mean (standard deviation) score of 5.14 (1.70) and 4.80 (1.83) respectively.

Additional factors that warrant description include Factor 4: Nonopioid Modalities, Knowledge & Confidence; Factor 5: Nonopioid Modalities, Negative Outcomes, and Factor 7: Stakeholder Preferences. They did not prove to be acceptably reliable with cronbach's alpha coefficients < .70, however all three had cronbach's alpha scores > .60, which indicates questionable reliability.

Factor 4: Nonopioid Modalities, Knowledge & Confidence

Nonopioid modalities, knowledge and confidence was associated with 5 PNOM items. A sample item includes item 35, "I believe that non-opioid modalities act at different pain receptors". Cronbach's alpha for this factor was .67. This factor assessed the CRNA's knowledge and confidence with the perioperative use of nonopioid modalities.

CRNA participants "strongly agreed" with the statements in this factor. Mean scores in this factor were 1.45 - 1.76, indicating CRNAs are knowledgeable and confident using nonopioid modalities.

Factor 5: Nonopioid Modalities, Negative Outcomes

Nonopioid modalities, negative outcomes was associated with 4 PNOM items. A sample item includes item 5, "I see poor analgesic effects from non-opioid modalities". Cronbach's alpha for this factor was .69.

CRNA participants tended to be neutral and "slightly disagree" with the statements in factor 5. They scored mean scores of 4.25 – 5.25 on the 4 items in this factor. CRNAs were neutral with item 39, "I have heard nurses say that patients have more postoperative pain when non-opioid modalities are used in surgery" (mean score 4.28, standard deviation 1.66) indicating PACU nurse perception may have an effect on CRNA beliefs.

Factor 7: Stakeholder Preferences

Stakeholder preferences inquired whether certain groups influenced the CRNAs use of nonopioid modalities. In this factor the input of patients, patient's families, surgeons, and anesthesiologists was assessed. Cronbach's alpha for factor 7 was .64.

CRNAs indicated that they "agreed" to "somewhat agreed" to being influenced by their patients (mean score 2.97, standard deviation 1.40) and surgeons (3.30, 1.50). They were neutral and "somewhat disagreed" to being influenced by anesthestiologists (3.88, 1.90) and patient's families (4.43, 1.57).

Discussion

This study aimed to validate the findings on the preliminary validity and reliability of the PNOM Questionnaire study conducted by Tucker and Wong[9]. The data collected in this current

study further strengthened the validity and reliability of the original pilot PNOM questionnaire. Subsequently, a valid and a highly reliable PNOM instrument could be used to elucidate the needs of CRNAs in reducing intraoperative opioid use.

As mentioned earlier, the opioid epidemic has eveolved into a national crisits that stems from multiple coplex factors including over-prescritpion and unnecessary exposure in the perioperative period. In an effort to achieve optimal intraoperative pain control and attenuate opioid administration by supplementing with non-opioid approaches, it is necessary to understand certified registered nurse anesthetists (CRNA) perspectives and practices.

The two main theories that form the basis of the PNOM research study are Bandura's Social Cognitive Theory (SCT) and the Item Response Theory (IRT). The Social Cognitive Theory is one of the most important theoretical frameworks that has shown to be useful in understanding and explaining human behavior.[13] It offers a theoretical foundation for explaining how people acquire and maintain certain behavioral patterns and is based on the assumption that social-cognitive determinants such as motivation, social support, and outcome expectation serve as a predictor of future behaviors.[14] This theory assumes that CRNA's decision to use of opioids or non-opioids is driven by their own perception of self-efficacy and that increasing CRNAs knowledge of multimodal analgesia will be the best way to reduce intraoperative opioid use.[9]

The Item Response Theory is a methodology used in developing, evaluating and scoring tests.[15] It proves the basis of establishing the reliability of each item it is measuring, as well as the construct that the items on the scale are trying to measure.[16] Each test item has its own item characteristic curve (ICC) and each subject response to an item is examined along this logistical curve.[9] The threshold and slope of each curve is examined to determine if the participant's response is correlated to the construct. A steep slope indicates that the item is more relevant to

the underlying constructs and items with shallow slopes are less relevant to the underlying constructs.[9,16]

Velasco's[2] initial qualitative study, from which the PNOM questionnaire was based, identified six barriers and four facilitators to non-opioid modalities perioperative use. The six barriers include opioid superiority, inconsistent analgesic effects of opioid alternatives, limited experience with opioid alternatives, limited opioid-alternative resources, negative experiences with intraoperative opioid-alternative administration, and patient comorbidities.[2] Facilitators include adverse effects of opioids, institutional policy and procedures, positive experiences with opioid alternatives, and regional anesthesia superiority.[2]

Out of the ten variables identified in Velasco's[2] research, the current study found a high correlation for all four facilitators for non-opioid modalities and only one barrier to non-opioid modalities perioperative use. The four facilitators are identified in this study as Theme 1 regional anesthesia time & efficacy with Cronbach's value of 0.93, theme 2: Nonopioid outcomes belief system with Cronbach's alpha value of 0.87, theme 3: Nonopioid institutional support with Cronbach's alpha value of 0.86, and theme 5: Nonopioid limited access and experience with Cronbach's alpha value of 0.71. The only barrier identified in the study was theme 4: Opioids outcomes belief systems with Cronbach's alpha value of 0.73.

The questionnaire results reinforce the literature stating that non-opioids are a safe and effective alternative to traditional opioid anesthesia management. Unsurprisingly, CRNAs agree, as evident by high Cronbach's alpha values of 0.87 for the non-opioid belief system. This finding is consistent with the Health Belief Model and Social Cognitive Theory, stating that our internal cognitive processes involve calculating risks and benefits and expectations related to the outcomes at various degrees.[17] It is also essential to highlight the data demonstrating that the

facilitators to non-opioid modalities have played the most significant role in determining if opioid-sparing techniques will be implemented.

Strength and Limitations

A significant strength of this study is the rigorous application of scale development procedures such as item development outlined by DeVellis[10]. The PNOM questionnaire item bank was developed based on Velasco's[2] research findings; rigorous pilot testing was conducted by Tucker and Wong[9].

Several limitations of this study include a small sample of CRNAs, which may limit the generalization of the findings to CRNAs across the nation and in various clinical settings. Another limitation is the disproportional response rate from female nurse anesthesia providers compared to males practicing in nurse anesthesia. Furthermore, there was a greater response rate from participants on Facebook (n=337) than responses recruited via AANA's listserv (n=190). It is difficult to rule out if the mode of recruitment impacted the participants' subjective responses. Furthermore, it was impossible to perform concurrent validity testing because our instrument is the first of its kind, and there were no other comparable instruments available.

Clinical Implications

The issue of barriers and facilitators of non-opioid approaches in the perioperative period is essential to undertake as an advanced practice nurse because of the current opioid crisis in the United States, with over 2 million people each year falling into opioid addiction after initial exposure in the perioperative period according to the American Association of Nurse Anesthetists.[18] Therefore, the CRNAs are uniquely positioned to implement change in practice that positively influences this opioid crisis.

At the time the original article by Velasco[2] was written, no other studies examining opioid-alternative strategies were examined specifically from CRNA practice. The PNOM questionnaire was designed to identify CRNA practice-specific barriers and facilitators to opioid-sparing or "opioid alternatives" approaches in the perioperative period. The critical information obtained from this tool to survey national CRNA practice can be used to make informed recommendations for practice, cultural, and policy changes.

Recommendations for Future Research

Recommendations for future research include capturing a larger sample of CRNAs across the nation to increase the generalizability of the PNOM questionnaire in various clinical areas. Another recommendation is to add a demographic question about participants' clinical settings. Such data will garnish information on variability in opioid and non-opioid practices specific to urban, suburban, and rural clinical settings.

Conclusion

This study aimed to ascertain the validity and reliability of the PNOM questionnaire pilot study conducted by Tucker and Wong[9]. Five factors were discovered using EFA after recruiting beyond the CRNA participants needed. EFA unveiled five themes from correlating questions: regional anesthesia time & efficacy, non-opioid outcomes belief system, non-opioid institutional support system, opioid outcomes belief system, and non-opioid limited access & experience. Findings from this study have significant implications even among all anesthesia providers. Elucidating underlying constructs behind beliefs and behaviors of opioid vs nonopioid administration among CRNAs found in this study will significantly impact, inform and positively influence future policy, practice and education.

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KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.870
Bartlett's Test of Sphericity	Approx. Chi-Square	6913.093
	df	741
	Sig.	.000

Table 1. PNOM Questionnaire KMO and Bartlett's Test

Communalities

	Initial	Extraction
Q1	1.000	.666
Q2	1.000	.601
Q3	1.000	.485
Q4	1.000	.643
Q5	1.000	.548
Q6	1.000	.586
Q7	1.000	.561
Q8	1.000	.564
Q9	1.000	.503
Q10	1.000	.594
Q11	1.000	.486
Q12	1.000	.778
Q13	1.000	.845
Q14	1.000	.624
Q15	1.000	.597
Q16	1.000	.547
Q17	1.000	.586
Q18	1.000	.918
Q19	1.000	.911
Q20	1.000	.527
Q21	1.000	.518
Q22	1.000	.753
Q23	1.000	.687
Q24	1.000	.755
Q25	1.000	.602
Q26	1.000	.495
Q27	1.000	.614
Q28	1.000	.644
Q29	1.000	.680
Q30	1.000	.699
Q31	1.000	.617
Q32	1.000	.473
Q33	1.000	.635
Q34	1.000	.704
Q35	1.000	.467
Q36	1.000	.658
Q37	1.000	.556
Q38	1.000	.548
Q39	1.000	.504

Extraction Method: Principal Component Analysis.

Table 2. PNOM Item Communalities

Factor	PNOM Questions	Cronbach's Alpha
1	**20, 27, 29, 30, 31, 32, 33, 34**	**.874**
20. I believe that non-opioid modalities will decrease postoperative nausea 27. I believe that non-opioid modalities are associated with less complications after surgery 29. Regional anesthesia causes fewer postoperative side effects than opioids 30. I believe that non-opioid modalities are safer than opioids 31. I believe that patients require less narcotic if they are use non-opioid modalities 32. I believe that patients prefer non-opioid modalities 33. Using non-opioid modalities allows for the reduction of the adverse effects of opioids 34. I believe that patients experience fewer side effects with non-opioid modalities		
2	**12, 13**	**.866**
12. My institutional culture supports the use of non-opioid modalities 13. I have ample non-opioid modalities at my disposal		
3	**1, 2, 4, 6, 7**	**.735**
1. I believe that opioids provide better analgesia than non-opioids modalities 2. I believe that the onset of opioid analgesia is faster than non-opioid modalities 3. I believe that the effects of opioids are predictable 6. I believe that opioids are safe 7. I find that patient emergence from anesthesia is smoother when I use opioids intraoperatively		
4	25, 26, 28, 35, 38	.666
25. I believe that non-opioid modalities are a valuable adjunct to an anesthetic 26. I will use non-opioid modalities if the options are required in protocols such as ERAS 28. Regional anesthesia allows me to use smaller opioid doses 35. I believe that non-opioid modalities act at different pain receptors 38. I feel confident using opioids		
5	5, 21, 37, 39	.694
5. I see poor analgesic effects from non-opioid modalities 21. I have had negative experiences using non-opioid modalities for analgesia 37. Non-opioid modalities have inconsistent analgesic effects for the treatment of surgical pain 39. I have heard nurses say that patients have more postoperative pain when non-opioid modalities are used in surgery		
6	**18, 19**	**.932**
18. The amount of time it takes to implement regional anesthesia influences my decision to use opioids 19. The amount of time it takes to implement regional anesthesia influences my decision to use non-opioid modalities		
7	14, 15, 17	.638
14. The treatment preferences of patients influence my use of non-opioid modalities 15. The treatment preferences of surgeons influence my use of non-opioid modalities 17. The treatment preferences of patients' families influence my use of non-opioid modalities		
8	4, 16, 36	.090
4. I understand the pharmacokinetics of opioids 16. The treatment preferences of anesthesiologists influence my use of non-opioid modalities 36. I have limited knowledge of the pharmacokinetics of perioperative non-opioid modalities		
9	8, 9	.120
8. I was trained to give opioids for first-line analgesia 9. I believe that non-opioid modalities decrease the risk of respiratory depression		
10	22	Cannot have single item as factor
22. I believe using non-opioid modalities is inappropriate for some patients based on their comorbidities		

11	**23, 24**	**.719**
23. I have limited experience with non-opioid modalities 24. I have a lack of non-opioid modalities at my disposal		

Table 3. PNOM Items by Factor with Cronbach's Alpha Coefficient
Bolded items indicate factors with proven reliability (cronbach's alpha > .70)

PNOM Item	Mean	Standard Deviation
Factor 1: Nonopioid Modalities, Positive Outcomes		
11. I believe that using non-opioid modalities can lower the risk of opioid addiction	2.12	1.28
20. I believe that non-opioid modalities will decrease postoperative nausea	1.97	.91
27. I believe that non-opioid modalities are associated with less complications after surgery	2.33	1.16
29. Regional anesthesia causes fewer postoperative side effects than opioids	1.90	.94
30. I believe that non-opioid modalities are safer than opioids	2.46	1.11
31. I believe that patients require less narcotic if they are use non-opioid modalities	1.83	.90
32. I believe that patients prefer non-opioid modalities	3.33	1.24
33. Using non-opioid modalities allows for the reduction of the adverse effects of opioids	1.87	.80
34. I believe that patients experience fewer side effects with non-opioid modalities	2.28	.97
Factor 2: Nonopioid Modalities, Institutional Support		
12. My institutional culture supports the use of non-opioid modalities	2.58	1.59
13. I have ample non-opioid modalities at my disposal	2.88	1.73
Factor 3: Opioid, Positive Outcomes		
1. I believe that opioids provide better analgesia than non-opioids modalities	3.94	1.42
2. I believe that the onset of opioid analgesia is faster than non-opioid modalities	3.20	1.50
3. I believe that the effects of opioids are predictable	2.89	1.26
6. I believe that opioids are safe	3.26	1.29
7. I find that patient emergence from anesthesia is smoother when I use opioids intraoperatively	3.02	1.43
Factor 4: Nonopioid Modalities, Knowledge & Confidence		
25. I believe that non-opioid modalities are a valuable adjunct to an anesthetic	1.45	.60
26. I will use non-opioid modalities if the options are required in protocols such as ERAS	1.70	.95
28. Regional anesthesia allows me to use smaller opioid doses	1.48	.69
35. I believe that non-opioid modalities act at different pain receptors	1.76	.82
38. I feel confident using opioids	1.68	.66
Factor 5: Nonopioid Modalities, Negative Outcomes		
5. I see poor analgesic effects from non-opioid modalities	5.25	1.28
21. I have had negative experiences using non-opioid modalities for analgesia	5.14	1.47

37. Non-opioid modalities have inconsistent analgesic effects for the treatment of surgical pain	4.47	1.43
39. I have heard nurses say that patients have more postoperative pain when non-opioid modalities are used in surgery	4.25	1.66
Factor 6: Regional Anesthesia, Time Required		
18. The amount of time it takes to implement regional anesthesia influences my decision to use opioids	4.68	1.67
19. The amount of time it takes to implement regional anesthesia influences my decision to use non-opioid modalities	4.61	1.61
Factor 7: Stakeholder Preferences		
14. The treatment preferences of patients influence my use of non-opioid modalities	2.97	1.40
15. The treatment preferences of surgeons influence my use of non-opioid modalities	3.30	1.50
17. The treatment preferences of patients' families influence my use of non-opioid modalities	4.43	1.57
Factor 8: Mastery of Pharmacokinetics		
4. I understand the pharmacokinetics of opioids	1.72	.60
16. The treatment preferences of anesthesiologists influence my use of non-opioid modalities	3.88	1.90
36. I have limited knowledge of the pharmacokinetics of perioperative non-opioid modalities	5.10	1.53
Factor 9: Random		
8. I was trained to give opioids for first-line analgesia	1.99	1.19
9. I believe that non-opioid modalities decrease the risk of respiratory depression	1.70	1.01
Factor 11: Nonopioid Modalities, Limited Access & Experience		
23. I have limited experience with non-opioid modalities	5.14	1.70
24. I have a lack of non-opioid modalities at my disposal	4.80	1.83

Table 4. PNOM Questionnaire Descriptive Statistics by Factor
7-point Likert-type scale: 1 = Strongly agree; 2 = Agree; 3 = Somewhat agree; 4 = Neither agree or disagree; 5 = Somewhat disagree; 6 = Disagree; 7 = Strongly disagree