



# Mediation of Predicted Poor Pain Outcomes in the Perioperative Pain Clinic

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Received: Oct 16, 2023

Accepted: Dec 04, 2023

Published Online: Dec 11, 2023

Journal: Annals of Anesthesia and Pain Medicine

Publisher: MedDocs Publishers LLC

Online edition: <http://meddocsonline.org/>

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**Keywords:** Perioperative pain; Pain management; Postoperative pain; Opioid use; Chronic pain; Acute pain; Postoperative opioid use.

**Abbreviations:** CMI: Case Mix Index; DRG: Diagnosis-Related Group; LOS: Length Of Stay; OME: Oral Morphine Equivalents.

## Abstract

**Background:** Poor pain outcomes after surgery can be predicted by factors, include psychological, psychosocial, and physical risks, which may be identified prior to surgery. The preoperative period is often a busy and stressful time for patients. This time, however, can be used to improve preoperative health which can result in better postoperative pain outcomes.

**Methods:** Patients referred to the Perioperative Pain Clinic from its opening in March 2017 through April 2023 who completed all clinic visits and surgeries were considered part of the study population. The opioid dose for the perioperative patients were noted in oral morphine equivalents at the first perioperative clinic appointment.

**Results:** From March 2017 to April 2023, there were a total of 1683 patients who completed an initial consult in the perioperative pain clinic and completed their surgical procedure. Of these, 829 patients were seen in the perioperative pain clinic both pre and postoperatively, and 854 patients were seen in the clinic only postoperatively. From the first perioperative visit to the 90-day postoperative visit, the average OME decrease was 23%. For the preoperative group, only 9.3 % of these patients were readmitted within the first 30 days after discharge compared to the postoperative group, which 8.7% of patients were readmitted. The preoperative group ED visit rate is 16% whereas the postoperative group has an ED visit rate of 22%.

**Conclusion:** The importance of opioid optimization prior to a surgery on the postoperative outcomes for patients is well known. Our multimodal approach for optimization and pain management has shown great success in our patient population, resulting in significantly improved patient outcomes, even with increased disease severity. As the perioperative pain clinic continues to grow, it will be important to note the continued success of preoperative pain optimization and postoperative pain management.



## Introduction

Optimal perioperative pain management is quintessential in enhancing patient recovery and mitigating potential sequelae, such as persistent postoperative opioid use and impaired wound healing. Especially noteworthy is the need for precise pain control for patients already engaging with opioids, since their management post-surgery presents a multifaceted challenge due to developed opioid tolerance and increased pain sensitivity, or hyperalgesia [1-6].

Addressing this challenge necessitates a comprehensive strategy that goes beyond conventional pharmacological interventions, which, while having their place, have shown limitations in providing sustainable postoperative pain management without inadvertently encouraging prolonged opioid use. Herein lies the pivotal role of innovative, multidimensional approaches in perioperative care, which carefully weave medical, physical, and psychological interventions into the patient's journey from pre-surgery through recovery.

The establishment of the Perioperative Pain Clinic at Duke in 2017 signifies a step toward a holistic and patient-centered approach, through a structured, three-phase model that extends from preoperative visits, through surgery, to postoperative care. The meticulous model aims not only to refine preoperative optimization but also to foster improved postoperative outcomes, patient satisfaction, and overall hospitalization course.

A key component and innovation within this approach is the incorporation of music therapy as a psychological intervention, intertwined with other strategies to mitigate pain and reduce opioid dependency [7-9]. Patients, during their preoperative period, are encouraged to engage in passive music therapy, choosing music that soothes and calms them. This engagement extends through their hospitalization and continues into the post-discharge period, providing a consistent, non-pharmacological medium to navigate through their pain and recovery journey.

This melds into a strategy that also includes physical optimization, notably through dietary modifications that prioritize anti-inflammatory foods, thus potentially enhancing wound healing and recovery. Moreover, medically, a multi-modal approach guides the reduction of opioid use [8]. Alternative pain management methods, such as using non-opioid medications and considering interventions like nerve blocks or injections when applicable, ensures opioids are reserved for managing breakthrough pain only.

The synergistic combination of these approaches, including the therapeutic application of music therapy, provides a framework that addresses not just the physiological aspects of pain management but also the psychological, supporting a rounded and sustainable recovery path for patients navigating through surgical procedures. Thus, integrating varied, non-pharmacological strategies alongside traditional medical interventions can pave the way for improved perioperative pain management, better surgical outcomes, and enhanced patient recovery and satisfaction.

With the observed clinical success of the clinic, we completed a retrospective analysis of the patients who were part of this novel perioperative pain optimization pathway.

## Methods

### Patient population

Patients referred to the Perioperative Pain Clinic from its opening in March 2017 through April 2023 (5 years and 2 months) who completed all clinic visits and surgery were considered part of the study population (Perioperative cohort). These patients completed at least one preoperative visit to the Perioperative Pain Clinic, their scheduled procedure, hospital discharge and at least one postoperative visit at the clinic within 90-days after their procedure within Duke Health System.

The data for the Perioperative cohort was collected through manual chart review. Those patients were then identified and removed from the primary dataset of all opioid tolerant inpatient surgical admissions from the same time frame. Per FDA guidelines, patients are deemed opioid tolerant if they use at least 60mg of oral morphine equivalents for at least seven days prior to admission [10]. Of the 8024 total inpatient surgeries, 176 of them comprised the perioperative group whereas the 7848 remaining served as control. Demographic information was also included for all patients.

### Opioid dose calculations

The opioid dose for the perioperative patients were noted in oral morphine equivalents at the first perioperative clinic appointment. They were then averaged to find the mean baseline opioid use for this patient cohort. The opioid dose for this cohort was also noted at hospital admission, hospital discharge and at 90-days postoperative. The average opioid dose was calculated for these time points as well. The difference in opioid doses from the first perioperative visit to admission and at 90-days was then calculated.

### Outcome calculations

All patient received standard of care for pain management during their hospital stay, provided by the primary care team and, when deemed necessary, pain specialists were consulted. Patients were discharged with pain medication prescriptions and follow up appointments according to the standard practice for the procedure endured. The perioperative patients were followed for a total of 90 days after surgery in the perioperative pain clinic, and were not limited in number of visits during that time.

The Length Of Stay (LOS) during a hospitalization is determined to be the average number of days spent in the hospital for all patients with similar diagnoses [11], which then becomes the expected numbers of admitted days for each specific patient for each hospitalization. By dividing the expected LOS by the actual LOS for each patient, we are able to calculate the average LOS index for each patient group.

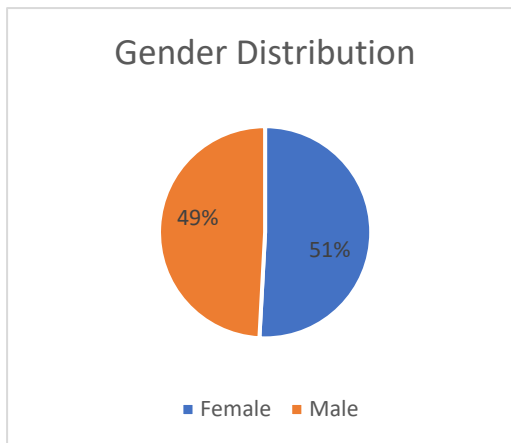
The next data we calculated was the 30-day readmission rate. We also looked at the Emergency Department (ED) visits for all patients. Both of these rates were calculated for patients admitted, either readmitted as an inpatient or admitted to the ED, to Duke University Health Systems. If these patients were admitted to other health systems, those results were not included in our data.

Case Mix Index (CMI), Although originally designed to determine reimbursements, is a common way to compare disease severity among patients with similar diagnoses<sup>12</sup>. The average CMI was calculated for both patient groups.

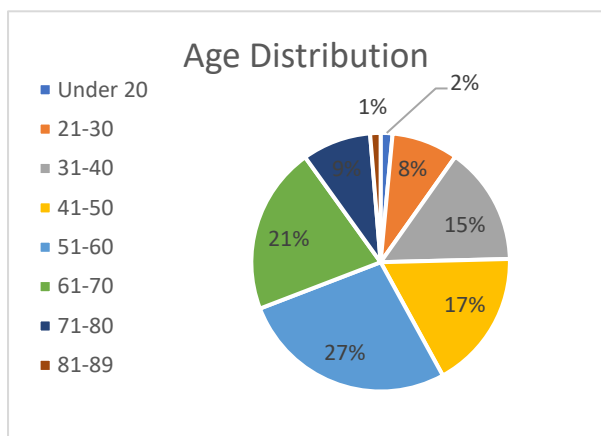
**Results**

From March 2017 to April 2023, there were a total of 1683 patients who completed an initial consult in the perioperative pain clinic and completed their surgical procedure. Of these, 829 patients were seen in the perioperative pain clinic both pre and postoperatively, and 854 patients were seen in the clinic only postoperatively.

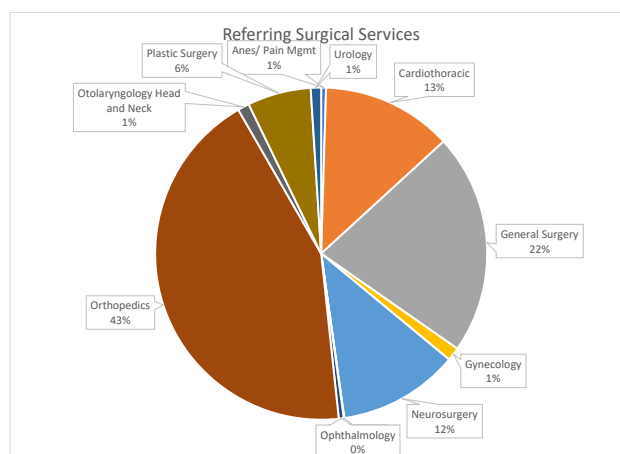
The demographic distribution demonstrated the youngest patient of the perioperative clinic patients was 15 and the oldest was 89 at time of service. The majority of patients (48.1%) were between the ages of 51-70 (**Graph 1**). The clinic saw more female patients (51%) than male patients (49%) (**Graph 2**). The majority of referrals (89%) to the perioperative pain clinic were from 4 services. These services were orthopedics (43%), general surgery (22%), cardiology (13%), and neurosurgery (12%) (**Graph 3**).



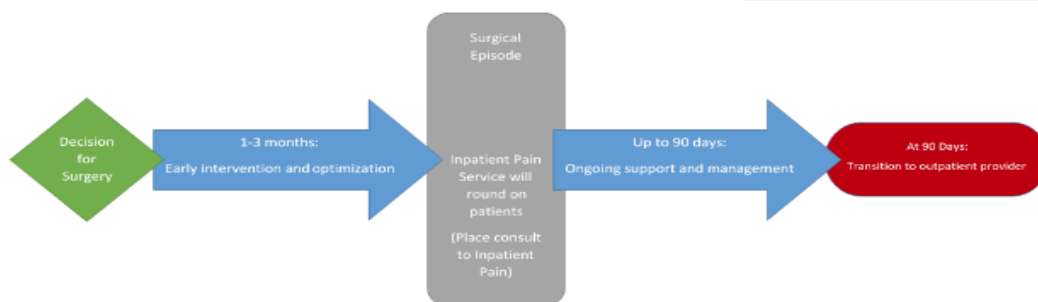
**Graph 2:** The Gender distribution of the perioperative clinic patients.



**Graph 1:** Heart Rate changes in the three groups.



**Graph 3:** Surgical service total referrals over the study period.



**Diagram 1:** Demonstrates the care model used for the perioperative group.

**Table 1:** Opioid changes by initial consult.

	Preoperative	Consults (829 pts)					Postoperative	Consults (854 pts)	*			
	Baseline, Prior to Surgery	Admit	Discharge	30D Post	60D Post	90D Post	Admit	Discharge	Initial Consult	30D Post	60D Post	90D Post
Average OME	96.4	67.5	134.3	99	77.1	74.5	46.8	130.9	127.8	101.9	79.9	65.9
Average OME Change Value		-28.9	37.9	2.6	-19.3	-21.9		84.1	81	55.1	33.1	19.1
Average OME Change Percent		-30%	39%	3%	-20%	-23%		180%	173%	118%	71%	41%
Binary OME Increase # of pts		164	554	259	163	125		676	595	423	319	192
Binary OME Increase % of pts		20%	67%	31%	20%	15%		79%	70%	50%	37%	22%
Binary OME Decrease # of pts		204	203	369	434	460		107	143	220	276	317
Binary OME Decrease % of pts		25%	24%	45%	52%	55%		13%	17%	26%	32%	37%
Binary OME No Change # of pts		461	72	201	232	244		71	116	211	259	345
Binary OME No Change % of pts		56%	9%	24%	28%	29%		8%	14%	25%	30%	40%

The median days between the preoperative visits in the Perioperative Pain Clinic were conducted 47 days prior to the scheduled procedure, and the postoperative patients had a median of 28 days after surgery seen in the clinic.

Our primary outcome was change in opioid dose as measured by Oral Morphine Equivalents (OME). During the time-frame from the preoperative visit to admission, the patient's opioid dose was tapered, with an average OME decrease of 30%. From the first perioperative visit to the 90-day postoperative visit, the average OME decrease was 23%. (Table 1) A binary analysis of opioid use (increase – decrease – no change) was also completed on this cohort. This demonstrated 25% of patients decreased their baseline opioid use by the time of admission. At 90-days after surgery, 55% of patients still were taking a lower dose than baseline.

The postoperative group had an average increase of 41% in OME from admission (their baseline dose) to 90-days after surgery. The binary analysis stated that 37% of patients were taking a lower dose of opioids by 90-days after surgery.

The average LOS for the patients in the study group was 1.4 overall, with preoperative cohort at 1.3 and postoperative cohort at 1.4.

For the preoperative group, only 9.3 % of these patients were readmitted within the first 30 days after discharge compared to the postoperative group, which 8.7% of patients were readmitted. The preoperative group ED visit rate is 16% whereas the postoperative group has an ED visit rate of 22%.

DRG Weight, a proxy for disease severity or CMI, for the perioperative group is measured at 4.4 overall, 4.3 in the preoperative cohort and 4.6 in the postoperative cohort.

## Discussion

The success of the perioperative pain clinic is based on innovation during all three phases around the surgery: preparation, surgery, recovery.

We believe that successful optimization for these patients was achieved through our standardized techniques during the preoperative period. At the start of the clinic, multiple avenues for optimization were offered to all patients. However, we have seen great impact with using the three approaches: Music therapy, dietary modifications and an opioid wean.

By effectively lowering the overall opioid dose for the perioperative clinic patients preoperatively by 18%, we observed significant overall outcomes for these patients. The decrease in hospitalization length was the first indicator of success of our clinic during the postoperative period. This statistically significant value in hospitalization length demonstrates that the perioperative patients were admitted, not only for fewer days on average than the control patients, but actually were admitted for a shorter time than expected based on their comorbidities and procedure. The reduced LOS is significant, in part, due to the increased average CMI for the perioperative patients. The average CMI for the perioperative group was considerably higher despite its lack of statistical significance. We would expect to see these patients, as a whole, to have increased LOS, and more ED visits and readmissions. However, all of these values are lower in the perioperative patients.

Although only the emergency department visit rate was statistically significant, both ED visits and readmission rates were

reduced for the perioperative patients. Meaning this patient group required less emergent and continuous care than the control group despite their overall increased disease severity. It is important to note that the readmission and ED rates were only calculated for admissions to our health system. However, we are confident our patients return to our health system, the system of their procedure, rather than other hospitals during their postoperative course.

We were able to achieve these impressive post-discharge outcomes through continued care after hospitalization. Not only were the readmissions and emergency department visit frequency decreased in the perioperative population, but also the average opioid dose at 90-days postoperative was significantly lower than their baseline dose.

The objective of the post discharge visits was to provide adequate and appropriate pain management, and encouraging compliance of their pain medications. Our ultimate objective was to decrease the opioid dose consumed to the minimum preoperative required dose for maximum efficacy postoperatively. It is widely considered a success for a patient returning to their baseline opioid dose after a procedure, rather than an increased dose. However, we have demonstrated our success in lowering postoperative opioid dose beyond baseline, as shown by the 44% decrease in postoperative dose.

It is important to note that the Strengthen Opioid Misuse Prevention (STOP) Act of North Carolina came into effect during our study period [13]. This change in legislation limits initial opioid prescriptions from hospital discharge. As this might effect some patient prescriptions within our study group, specifically those who tapered completely off opioids prior to their procedure, we do not believe these restrictions influenced our patients significantly, since these patients are identified as chronic opioid users.

A decrease in the total opioid dose preoperatively resulted in improved postoperative outcomes. Instead of starting out the postoperative period in a difficult position with poor expected outcomes, high opioid dose requirements, and significant postoperative pain, we are able to set patients up for a successful surgery and recovery, when seen in the perioperative pain clinic prior to their procedure with follow up after discharge.

## Limitations

The major limitation of this study noted is the sample size. There were a total of 8024 scheduled procedures performed in patients using chronic opioids in the Duke Health System during our study period. However, only 2% (176 patients) were followed by the perioperative pain clinic. Another limitation of this study is location. Despite Duke Health System treating a wide demographic of individuals from a wide geographic radius, this clinic is only located within our hospital system. This limits the subset of patients to those treated within our system, and therefore should be tested and verified outside of an academic hospital setting.

As noted above, North Carolina's STOP Act became effective during our study time and may influence the postoperative (90-day) opioid dose. This legislation would, however, impact both the study and the control populations.

## Future directions

The goal of the perioperative pain clinic is to optimize the pain control, opioid use and opioid compliance within the

chronic pain population during the time surrounding a procedure. Standardized utilization of the perioperative pain clinic among opioid using patients within the Duke Health System is our first step toward achieving this objective. As Duke's perioperative pain clinic was the first in the nation, and one of the only clinics of its kind, we aim to further pain management strategies for chronic pain patients. With the growth of the clinic, and other similar clinics, it will be important to reveal the continued advancements in care for this population. It will also be important to study the financial risks and benefits of these clinics. We know that lower resource utilization decreases the patient financial burden. However, it will be important to compare resource utilization reduction costs with to the cost of maintaining such a clinic as these.

### Conclusion

The importance of opioid optimization prior to a surgery on the postoperative outcomes for patients is well known. Our multimodal approach for optimization and pain management has shown great success in our patient population, resulting in significantly improved patient outcomes, even with increased disease severity. As the perioperative pain clinic continues to grow, it will be important to note the continued success of preoperative pain optimization and postoperative pain management.

### Disclosure of funding

**Conflicts of interest:** None.

**Clinical trial number and registry URL:** NA.

**Individual Author Contribution(s):** Amanda Nelli helped with data collection and analysis, results analysis and manuscript preparation.

Padma Gulur helped with data collection, validation, and results analysis and manuscript preparation.

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