

Development of a Simple Risk Prediction Model for Excessive Postoperative Opioid Utilization in Inpatients

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Background: Chronic post-surgical pain (CPSP) - pain lasting for >3 months after surgery - affects up to 30% of patients [1]; 5-10% of patients report severe pain 1 year after major surgery [2]. CPSP increases the risk of prolonged opioid use; specifically, 3-10% of opioid-naïve patients have been found to have ongoing opioid use 3-6 months after surgery [1,3,4]. Risk factors for CPSP and long-term opioid use include current opioid or benzodiazepine use, a history of chronic pain or poorly controlled post-surgical pain, depression/anxiety, substance use disorder, recreational drug use, age, gender, and type of surgery [4-10].

Objective: To develop and refine an electronic pre-operative assessment tool for predicting the risk of prolonged post-surgical pain and opioid use.

Methods: The requirement for research ethics approval was waived for this quality improvement project. Patients presenting for colorectal surgery completed an online pre-operative questionnaire using the Thrive Health platform (Vancouver, Canada). It included demographic data, medication history, and screening questions for risk factors of CPSP and opioid use. A risk score was generated, with manually assigned weights: score range 0-35 points, high risk threshold ≥ 10 (Table 1). Initial clinical use suggested potential for optimization. High inpatient post-operative opioid utilization, defined as >90mg of morphine equivalents/day, was used as the primary outcome. A logistic regression model was created, using the same risk factors as the manual risk score; 60% of the data was used for training and 40% for testing. Performance of the two risk scores were compared on a test set of 49 patients using accuracy and positive vs. negative class predictions.

Results: Data from 122 patients, who completed the survey between April and October 2020, were available for model evaluation and optimization: 35/122 (29%) had a high manual risk score, and 22/122 (18%) had elevated post-operative opioid utilization. The manual risk score had an accuracy of 65% (95% CI 55% to 75%), the logistic regression 78% (95% CI 65% to 86%) of the test cases. History of chronic pain, antidepressant use, substance use disorder, and open surgery were the four most important risk factors in the regression model.

Conclusion: Based on this initial analysis, we will re-weight the factors used to create the risk score and collect additional data to identify a more optimal threshold. The "open surgery" risk factor may need removal, as it is not known to patients at the time of survey completion. Future steps include collecting longer term post-operative pain and opioid use data via the Thrive Health and Careteam Technology (Vancouver, Canada) online platforms, as part of the

Reducing Opioid Use for Pain Management Digital Technology Supercluster Project, and using these data for risk prediction modeling.

References:

[1] BJA CEPD Reviews. 2010;10(1):12–14. [2] PAIN: Clinical Updates. 2011;19(1). [3] BMJ. 2014;348:g1251. [4] Ann Surg. 2020;271(5):845-854. [5] Anesthesiology. 2000;93(4):1123–1133. [6] Lancet. 2006;367(9522):1618–1625. [7] Expert Rev. 2009;9(5):723–744. [8] Pain. 2003;105(3):415–423. [9] Pain. 1998;75(2–3):177–185. [10] Eur J Anaesthesiol. 2015;32(10):725–34.

Table 1: Risk factors for the significant postoperative opioid utilization risk score

Screening questions, dichotomized into risk factors for calculation	Manually Tuned risk factor weights	Logistic Regression weights
Score range	0-35	0-2
Score threshold	10	0.5
Current prescription opioid use	5	0.20
History of chronic pain	5	1.45
Current prescription benzodiazepines use	2	0.22
History of anxiety or panic attacks	2	0.42
Current prescription of antidepressants	2	-0.12
History of depression	2	-0.37
Substance use disorder (past or present)	5	1.09
Recreational drug use	5	0.07
History of poorly controlled pain after surgery	4	-0.36
Age <40 years	1	-0.03
Female sex	1	0.39
Open surgery	1	0.70