Machine-learning-assisted model addresses overprescribing and underprescribing of opioids

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While the COVID-19 epidemic may have taken over the headlines the last two years, the United States remains in the grip of the opioid

epidemic. Nearly 70,000 Americans died from opioid overdoses in 2020, the last year for which there are federal statistics available. New research may suggest fewer of those deaths are attributable to prescription opioids, the result of years-long efforts by physicians and other providers to reverse overprescribing trends. Prescribing patterns, including those after surgery, have been implicated as a significant contributor to the U.S. opioid crisis.

Now, a multidisciplinary team of physicians and scientists at Beth Israel Deaconess Medical Center (BIDMC) have designed an intervention—a model that uses machine learning to improve post-surgical opioid prescribing. Based on one of the largest reported data sets of its kind, the intervention provides physicians with patient- and procedure-specific opioid consumption predictions at the time of patient discharge. Additionally, the model continually collects and updates data and provides near-real-time feedback for prescribers. The team reports on the design, implementation and clinical impact of the machine learning-assisted intervention in *NEJM Catalyst*.

"Machine learning is uniquely suited to tackle the task of personalizing opioid prescriptions after surgery to individual patient characteristics—so that the risk of both overprescribing and under prescribing are minimized," said senior author Gabriel A. Brat, MD, MPH, surgeon in Trauma and Surgical Critical Care in the Department of Surgery at BIDMC. "Over the course of two years, our intervention promoted safe, personalized opioid prescribing after surgery and promoted durable behavior change in prescribing habits. We believe our experience offers generalizable lessons and tools for other health systems ."

The machine learning-assisted intervention rests on patients' actual opioid consumption—data that is not typically captured. Beginning in October 2017, Brat and colleagues began calling BIDMC patients after

surgery to conduct surveys about how much pain medicine they were prescribed versus how much they needed and consumed. In 2019, the researchers switched to automated text messages that directed post-surgical patients to a web survey. By August 2021, the team had post-discharge opioid consumption data on nearly 11,000 post-surgical patients.

"Understanding patients' actual opioid consumption is key to designing an evidence-based intervention," said Brat, who is also an assistant professor of surgery at Harvard Medical School.

These patient-reported opioid consumption data were combined with patient characteristics from electronic health records to develop a model predicting typical opioid-consumption patterns after common surgical procedures. The top five predictors of opioid consumption include the amount taken while in the hospital, history of cannabis and tobacco use, age, body mass index, and pre-surgical opioid exposure. By highlighting which patients are likely to have atypical opioid consumption, the model gives providers guidance as they develop discharge plans for patients.

Moreover, the system gives physicians feedback about their own prescribing habits, alerting them when they've written atypically large opioid prescriptions. The alert comes in the form of an email that includes data on patient opioid consumption metrics and a link to a survey asking prescribers to provide rationale for prescription size.

Over the course of two years, the intervention was associated with a reduced size and reduced frequency of inappropriately large opioid prescriptions. In addition, the team of physicians and scientists observed that prescribing practices evolved to be closer to typical patient opioid consumption and the volume of excess pills prescribed dropped significantly.

To better understand if the clinical prediction model could be deployed at other institutions, the BIDMC team validated their model using patient-level consumption data from a healthcare system in Utah and commonly-used prescribing guidelines developed by a Michigan-based research consortium. The models performed well in predicting a typical opioid consumption among patients relative to these common guidelines.

"These analyses revealed that our model retains substantial predictive utility across different institutions and patient populations," said Brat. "We recognize that many hospitals may not have the infrastructure or resources to implement a system like this, and we aim to help other institutions develop and deploy similar interventions to amplify the benefit of multi-institutional opioid consumption data."

Experts from departments across BIDMC were involved in the intervention's design, deployment and evaluation. A team of surgeons, surgical residents and data science postdoctoral fellows designed the intervention. Clinical informaticists and specialists in electronic medical records integrated each element of the intervention into the hospital's existing IT systems.

More information: Machine Learning to Improve Opioid Prescribing Practices. *NEJM Catalyst*. catalyst.nejm.org/doi/full/10.1056/CAT.22.0119

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