

# In a World of Stigma and Bias, Can a Computer Algorithm Really Predict Overdose Risk?

*A Machine-Learning Algorithm Is Being Deployed Across America to Prevent Overdose Deaths. But Could It Be Causing More Pain?*

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In the middle of an October night in 2020, 40-year-old Nita Enyeart suddenly awoke with radiating pain. She stayed up all night trying to self-treat the throbbing twinge emanating from her back with heat, ice, numbing creams, hot baths, and hot showers. Nothing worked. Years earlier, Enyeart had undergone surgery for kidney stones and she remembered that the surgeon had told her that they could recur. Believing that to be the cause of her pain, she went to the emergency department closest to her small town in Louisiana.

The clinical team at St. Tammany Parish Hospital immediately diagnosed a kidney stone. Enyeart breathed a sigh of relief thinking she would receive a couple days' worth of pain medicine and be on her way while the kidney stone passed. However, the dynamic between her and the clinical staff took a sharp turn. "Everything suddenly changed," Enyeart told *Annals*. "It was like they flipped a switch." Baffled by the sudden shift in demeanor, Enyeart asked the nurse what was wrong. "We saw your score

and saw that you were trying to seek drugs," the nurse responded.

"My score? What do you mean?" Enyeart was puzzled over the accusation of being a "doctor shopper" or "drug seeker." She had a kidney stone. Of course she wanted pain control. It was at this moment when Enyeart first learned about her "NarxCare scores."

On the basis of a machine-learning algorithm that trawls state-governed Prescription Drug Monitoring Program (PDMP) databases, NarxCare scores purport to predict a patient's risk of prescription drug overdose. The higher the score the higher is the risk of unintentional overdose according to Bamboo Health, formerly known as Appriss, the health technology company that designed the algorithm that is being used in hospitals across the country. The overdose risk algorithm is embedded within NarxCare, Bamboo Health's flagship product.

Enyeart was one of several patients interviewed by *Annals* who recalled harrowing stories of being denied adequate pain care in emergency settings. For some patients with complex medical histories and chronic pain wondering why their pain is suddenly going undertreated, the answer may be

a high-risk NarxCare score. "I feel like I've been reduced to a number," said a 41-year-old woman in North Carolina who suffers from ileus. (She requested anonymity for privacy concerns.) "After they see that score, we just get brushed off," said TameraLynn Stewart, a patient with chronic pain living in Oklahoma. "We have complex diseases, we're not doctor shoppers," said Jennifer, a patient with lupus in Ohio (who requested *Annals* not to use her last name for privacy).

Databases, dashboards, and machine-learning algorithms are inundating the medical field, promising "objective" and data-driven assessments that can streamline care and better inform on-the-fly clinical decisionmaking. However, what happens when an algorithmic approach is applied to a phenomenon as vast and complex as America's worsening polysubstance overdose crisis that killed more than 100,000 people in the year-long span ending in April 2021?<sup>1</sup> Do these algorithms really prevent overdose deaths and prescription opioid misuse? Or, as many experts worry, do they mostly just prevent patients with disabilities and chronic pain from receiving medications they may need?

In addition to her history of kidney stones, Enyeart experiences chronic pain stemming from a car accident she had in 2014. She had no idea what her overdose risk score was or why her score was so high that it warranted being denied treatment for kidney stones. "I went home and cried for 3 days," she said with a tremble in her voice. Enyeart could only speculate, but she thinks that her long history of seeking treatment for her other chronic pain, what she described as "never-ending doctor's appointments," may have been the main contributor to her risk score. Whatever the reason, she said that she felt discriminated against.

St. Tammany Parish Hospital did not return a request for comment about the policies and procedures regarding the hospital's use of NarxCare.

According to Bamboo Health's fine print, "NarxCare scores and reports are intended to aid, not replace, medical decision-making."<sup>2</sup> Nishi Rawat, MD, Bamboo Health's Chief Medical Officer, told *Annals* that "Doctors should not be making decisions in a vacuum and single handedly deny care based on a score, based on a single number."

"Talk to the patient," Dr. Rawat said. "Don't let algorithms decide."

A recent cover story of WIRED Magazine found that patients with high risk scores tended to be chronically ill and disabled and happened to be overwhelmingly women.<sup>3</sup> Rather than having substance use disorder, they more often tended to be high health care utilizers because of complex chronic conditions. Their scores were cited as a reason for the denial of pain relief, much like the patients interviewed for this story. According to WIRED, many researchers believe that NarxCare scores and other similar screening tools are "profoundly flawed."

Can a physician really know whether an algorithm is accurate?

The regulatory environment for machine-learning algorithms and artificial intelligence is still adapting to an emerging market. Unlike medical devices and pharmaceuticals, the Food and Drug Administration does not require an arduous approval process for artificial intelligence products currently being used in health care settings. Bamboo Health's NarxCare algorithm had not been independently validated and peer-reviewed until recently, well after it was rolled out in many hospitals.

An October 2021 study published in *Drug and Alcohol Dependence*

concluded that NarxCare scores "may serve as a useful broad-based universal screen for risky opioid medication use among community pharmacy patients" but also noted that the study's findings "may only be applicable to states/regions wherein data were collected," which were Ohio and Indiana.<sup>4</sup> To be sure, the study did not focus on patients prescribed opioids in emergency settings. The validation study found that the NarxCare scores had a false-positive rate of 17.2% and a false-negative rate of 13.4%.

"For me, it's all in the false-positive and false-negative rate," Scott Weiner, MD, MPH, of Brigham and Women's Hospital in Boston told *Annals*. "You have almost one third of patients being misclassified. That's substantial. What do you do with that information?" For most clinical screening tests, Dr. Weiner added, the standard for accuracy is typically >90%.

Although every state owns and manages the data stored in PDMPs, Bamboo Health's risk algorithm is considered proprietary, and therefore, the details are considered a trade secret. *Annals* found and reviewed several NarxCare user manual documents, including the one used by the Louisiana Board of Pharmacy that partially spell out which variables and inputs lead to a high risk score. "For the first version of the score, more than 70 PDMP variables were evaluated with 12 chosen for the final model," the user manual says. Five of those variables are the number of prescribers, number of pharmacies, daily morphine milligram equivalents prescribed, concomitant use of controlled substances, and, finally, any overlapping prescriptions. According to Dr. Rawat, the risk scores only use information stored in PDMPs.

The manual states that the 5 main variables are "literature-based risk

factors" that are predictive of unintentional prescription drug overdose and that the "absolute risk of death from unintentional overdose is very low" in patients with a record in the PDMP.

"Each of the inputs for these algorithms have so many problems that I wouldn't feel comfortable making clinical decisions based on this kind of a score," Nabarun Dasgupta, PhD, MPH, a senior scientist at the University of North Carolina's Injury Prevention Research Center, told *Annals*. "If people knew what goes into the sausage, I think they would rapidly abandon this score."

Dasgupta specializes in large database analytics and is studying the validation of PDMP data. "There are so many instances where the number in the PDMP doesn't reflect a patient reality." For instance, it is simple to figure out whether a prescription was paid for in cash on the ground level, but at a surveillance database level, Dasgupta said that input is far from clear. Dasgupta also noted that there are numerous ways to calculate the morphine milligram equivalents prescribed and that each formula produces different results, which could also influence a patient's score.

According to Dr. Rawat, overlapping prescriptions is one of the more significant variables that goes into the risk score. "If you are someone who suffers from chronic pain, your score will not be elevated as long as you're getting what we call coordinated care, meaning you don't have much overlap in your prescriptions," Dr. Rawat said.

Stefan Kertesz, MD, MSc, an addiction medicine specialist at the University of Alabama at Birmingham, said that one type of bias he sees is related to the number of prescribers a patient has. If someone receives care in a teaching hospital, it may look

like they have numerous prescribers, which he says is very different from “doctor shopping.”

An April 2021 study in *Drug and Alcohol Dependence* described “doctor and pharmacy shopping” as a “fading signal.”<sup>5</sup> For example, the study found that “common data-driven algorithms” misclassified 20% of patients with cancer—who often see multiple specialists—as “doctor shoppers.” That study’s authors note that PDMPs lack diagnostic information and other critical patient context, which limits the ability of PDMP data to distinguish between opioid misuse, doctor shopping, and overdose risk and what is actually clinically appropriate use. The study’s authors concluded that to avoid unintended consequences, “more nuanced and sophisticated approaches are needed.”

Can those at risk of overdose be identified in other ways? Yes, but learning such information requires old-fashioned rapport and trust building between doctors and patients. Experts in substance use disorders told *Annals* that the single best predictor of a future overdose is an overdose in the past. However, that risk factor does not appear in the PDMP databases and, therefore, does not figure into the algorithm’s overdose risk score. In reality, the vast majority of overdose deaths today involve illicitly manufactured fentanyl or other drugs purchased in the illegal market, such as methamphetamine. This means that those with the most risk of overdose could have a risk score of 0 because the drugs they use are not prescribed by doctors.

“When prescribers use these scores, they have to understand that the information is *only* related to what’s available in the PDMP,” Weiner said. “It’s inherently limited because of that.”

In 2020, Dr. Weiner coauthored a study that asked physicians to

respond to “enhanced” PDMP patient profiles, such as algorithmic risk scores.<sup>6</sup> Physicians expressed concern about their legal liability when prescribing to patients deemed to be high risk. More than one emergency physician interviewed for the study thought that the overdose risk scores were a potential impediment to treating pain. As one doctor quoted in the study put it, “I’ve got red warnings coming at me, which makes me feel like the medical board may be after me if I do anything to control his pain.”

A climate of increased surveillance combined with a national effort to drive down opioid prescribing has put clinicians between a rock and a hard place, said Jennifer Oliva, JD, MBA, who directs the Center for Health & Pharmaceutical Law at Seton Hall Law. “On the one hand, they have these patients that are complex, and on the other hand, they have law enforcement and state boards surveilling their activities through databases that produce red-flags and alerts on them,” Oliva said. “I think they’re in a tough spot.” Oliva has argued for much tighter regulation and oversight of machine-learning algorithms like NarxCare.<sup>7</sup>

Oliva noted that opioid prescribing has plunged by 60% since 2011. However, overdose deaths have continued to soar to greater and grimmer heights, translating to approximately 275 Americans dying every single day from a drug overdose. The latest mortality data make clear that America’s overdose crisis is no longer being driven by pill mills, prescription opioid misuse, or doctor shopping. Moreover, there are no data to support the notion that tighter opioid prescribing and enhanced PDMP surveillance have resulted in fewer overdose deaths. In fact, recent analyses show that the more opioid prescribing declined in certain counties, the growth in overdose

death rates became steeper in those areas.<sup>8</sup>

“There’s definitely been a decrease overall in the population of patients who are doctor shopping,” Jeanmarie Perrone, MD, professor of emergency medicine at the University of Pennsylvania, told *Annals*. “It’s not nearly what it was 5 years ago. It’s quite the exception that you’ll find somebody in that scenario.”

“I don’t really need a Narx score if I’m already in the PDMP and I can see the patient’s prescription history,” Perrone added. “You should really be looking at the PDMP for an opportunity to start a conversation with a patient.”

Other emergency physicians echoed Perrone’s sentiment that any information gleaned from the PDMP or risk scores ought to be used to start a conversation with a patient, not end or deny care.

“Despite all the criticisms of these scores, I’m still supportive,” Dr Weiner said. “If the score is high, let me talk to the patient and ask what’s going on. But unfortunately, there is so much stigma around this, both for substance use disorders and chronic pain, that these conversations are not happening.”

Finally, physicians who work in emergency medicine settings pointed out that PDMPs were not originally designed for clinical practice. “PDMPs were really a law enforcement creation,” Kathryn Hawk, MD, MHS, an assistant professor of emergency medicine and epidemiology at Yale University, told *Annals*. “They were never designed for medical care or to be a clinical tool to drive prescribing or medical care.”

“I feel very strongly that there is a role for opioid prescribing in medicine and I think it’s important that we be conscientious about treating pain,” Hawk added. “We don’t want the pendulum swinging back too far

to where we're unwilling to adequately treat people's pain."

Patients like Nita Enyeart feel strongly that they are victims to the swing of that pendulum. "I personally know 3 people who have committed suicide because their pain was untreated," Enyeart said. What she and other patients want is to be seen as more than a number.

*Section editors:* Truman J. Milling, Jr, MD, and Jeremy Faust, MD, MS  
*Funding and support:* By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see [www.icmje.org](http://www.icmje.org)). The author was paid by ACEP to research and write this article.

The views expressed in News and Perspective are those of the authors, and do not reflect the views and opinions of the American College of Emergency Physicians or the editorial board of *Annals of Emergency Medicine*.

<https://doi.org/10.1016/j.annemergmed.2022.04.006>

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