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Assessing Prescription Opioid Risk With Predictive Analytics

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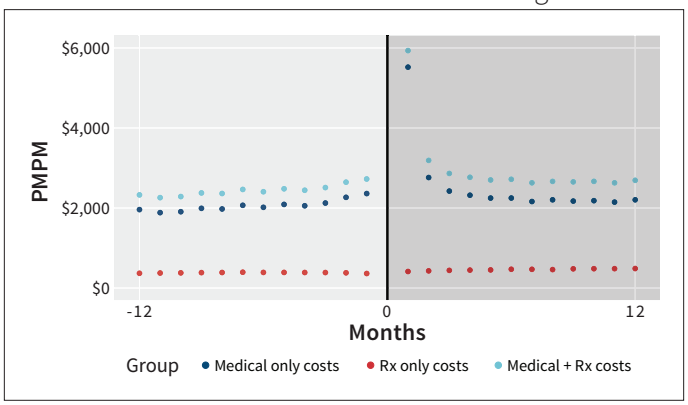
Figure 1
Medical Costs of Individuals With an OUD Diagnosis



According to the Centers for Disease Control and Prevention (CDC), it is estimated that more than 115 people die each day in the United States as a result of opioid overdose and that prescription opioid misuse costs more than $78.5 billion per year.[1] The uptick in opioid-overdose-related deaths and misuse has developed since the late 1990s for a variety of reasons, including:

- An increased number of prescription opioids given to patients for pain management combined with increased quantities
- Increased influence from pharmaceutical companies, including an emphasis on pain as the fifth vital sign and extending marketing from pain specialists to primary care and emergency room doctors[2]
- Lack of coordination and insight (on the part of both physicians and pharmacies) into patient opioid consumption[3]
- Lack of education regarding alternative treatment modalities for those with non-cancer chronic pain[4]
- A transition to illicit drugs by those who first develop an opioid use disorder (OUD) on prescription drugs[5]

Preventing further patient harm is critical, not only for the health of the individual and their family, but also because of the increased cost associated with an opioid dependence disease remaining untreated. We analyzed a large data set that includes information on tens of millions of individuals and over eight years of medical and pharmacy claims history. As a result of this analysis, we estimated the average overall medical cost (inclusive of pharmaceuticals) for a patient newly diagnosed with OUD is between $470 and $508 per member per month (PMPM) higher in the year after a member's OUD diagnosis than the year before (see Figure 1). This cost estimate may vary across Medicaid, Medicare or commercial populations.

The opioid epidemic is a complex public health crisis with no simple solution available for solving the problem. All stakeholders need to proactively work to improve the situation. Some of the current efforts by stakeholders include the following:

- Physicians and pharmacists utilizing state electronic prescription drug monitoring program (ePDMP) systems prior to prescribing and dispensing opioid medications
- Centers for Medicare & Medicaid Services (CMS) enacting guidelines to restrict access for high-risk beneficiaries
- State legislators restricting the days' supply for an initial prescription by enacting legislation
- Health plans improving provider education and risk assessment
- Substance Abuse and Mental Health Services Administration (SAMHSA) increasing access to naloxone and medication-assisted treatment (MAT)
- Health care providers improving efforts to integrate information sharing

While many of these efforts will likely have a positive impact on the opioid crisis in the long run, there is also an opportunity to improve and advance the area of prevention and screening. Many screening tools today are a set of questions clinicians ask patients, and which rely on self-reported data. The CDC has called into question the accuracy of these tools and their effectiveness in reducing harm because the evidence and results of these tools were inconsistent.[6] Additionally, not everyone has their risk assessed before opioid prescriptions are written.

Bob Twillman, Ph.D., executive director for the Academy of Integrative Pain Management, states, "Every patient should be screened; it's the right thing to do. Undiagnosed OUD results in increased costs due to doctor shopping, increased utilization and increased social program support."

Mark McGrail, M.D., family and addiction services physician at Cherokee Health System mentions, "Cherokee has made screening universal and is done at every intervention within our integrated care model."

Screening and assessing large numbers of either opioid-naive or high-risk chronic opioid users is made easier with an approach that scales. Data science may provide one avenue to assist with the opioid epidemic. Data science can review patterns in historical data to identify common criteria that could lead to OUD diagnosis. These patterns may not be easily identifiable through a manual review of the data.

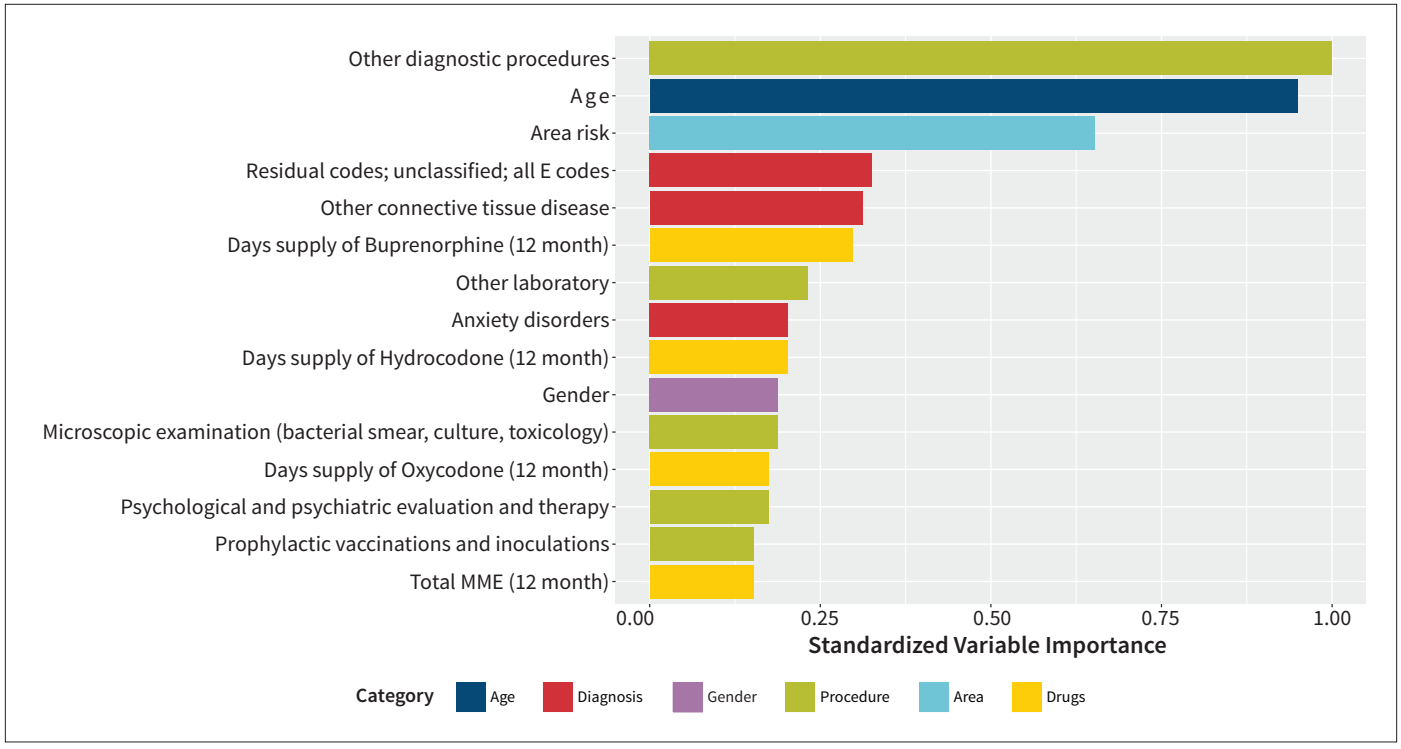
PREDICTING THE LIKELIHOOD OF OUD DIAGNOSIS

Milliman developed an algorithm using actuarial concepts and data science techniques, including artificial intelligence and predictive analytics, to predict the likelihood of receiving an OUD diagnosis in the next 90 days. This algorithm was performed on our large data set and took into account an individual's demographic, medical and pharmacy data. The algorithm is based on a gradient boosted machine (GBM) model, which is a decision tree ensemble model. This approach combines the prediction from hundreds of individual decision trees to come to a final consolidated estimation. The GBM model provides the ability to capture nonlinear relationships between the dependent variable and over 1,600 predictors in addition to predictor interactions. The output of the GBM model is risk scores related to the likelihood of an OUD diagnosis, along with associated contribution factors based on the data assessed, of individuals. The goal is to allow full transparency for further clinical assessment and targeted case management.

Initial results of our algorithm have been promising with an area under the curve (AUC) of 0.914. AUC is a calculation that is commonly used to demonstrate the accuracy of the model; values closer to 1 indicate that the model is more likely to rank a person who will have an OUD diagnosis in the future higher than an individual who will not. With a value of 0.914, our model is at least as predictive as similar opioid assessment tools.

Figure 2 displays some sample variables that are potential contribution factors for an individual, along with their relative

Figure 2
Relative Variable Importance Using Demographic, Pharmacy and Clinical Classification Software (CCS) Categories



For more information on CCS, see *https://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp* (accessed June 22, 2018).

importance in predicting OUD diagnoses. The ranking of the predictors in Figure 2 indicates how key the factor can be in determining a person's risk of an OUD diagnosis, but does not represent a linear relationship. For example, the age of an individual is a strong predictor of the risk of an OUD diagnosis in the next three months, but a person is not necessarily more likely to receive an OUD diagnosis as they get older.

Based on our algorithm, the top three variables in Figure 2 (other diagnostic procedures as defined by CCS, age and geography) are among the most important variables in determining the likelihood of receiving an OUD diagnosis. By combining these demographic variables with medical and pharmacy claim information, our algorithm is able to identify individuals who are most likely to be diagnosed with OUD in the near future (90 days).

Note that the current version of the predictive analytic model is calibrated around predicting a member's likelihood of receiving an OUD diagnosis due to the importance of identifying these individuals for potential treatment to mitigate the current epidemic. Another potential use for this type of predictive analytics algorithm is a refinement to identify individuals likely to be diagnosed with other diseases. For example, this type of predictive modeling on individuals and their claims data to identify who may be diagnosed with diabetes, stroke (including long-term complications) or chronic obstructive pulmonary disease (COPD) would allow for quicker intervention, potentially before these events occur. This early intervention could significantly improve the outcomes for these individuals and potentially reduce their medical costs.

Properly understanding risk and context is important to assessing whether a patient should be prescribed opioids. There are cases where opioids may be appropriate for specific acute events and chronic pain situations. Pain management professionals, primary care physicians, surgeons and dentists are best positioned to make these clinical judgments. Additionally, there is active research assessing the outcomes of other treatment modalities, including MAT, opioid tapering strategies, physical and occupational therapy, nonsteroidal anti-inflammatory medication alternatives, lifestyle changes, psychological support and alternative medicine (like acupuncture and chiropractic services). Inputting these outcomes into the feedback loop for risk assessment purposes will help improve future predictions.

Screening and risk assessment are critical to exercising sound clinical judgment and making effective care decisions. OUD diagnoses have continued to increase over the past several years.[7] A multifaceted approach to attacking the problem, including widespread opioid assessment and screening, will play a larger role in reducing societal harm in the future. ■

Please note the opinions stated in this article are those of the authors and do not represent the viewpoint of Milliman. Andrew Gaffner and Barbara Collier are members of the American Academy of Actuaries and meet the qualification standards of the Academy for sharing the information in this article. The underlying data was provided by various contributors and was accepted without audit. However, the authors did review it for general reasonableness. If this information is inaccurate or incomplete, conclusions drawn from it may change.

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ENDNOTES

1 CDC/NCHS, National Vital Statistics System. Mortality. CDC Wonder, Atlanta: U.S. Department of Health and Human Services, CDC. 2017, *https://wonder.cdc.gov* (accessed June 21, 2018).

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