Drug Seeking Behavior and the Opioid Crisis

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Abstract

Both private and public health institutions have been trying to find ways to combat the growing opioid crisis. One suggested strategy has been to identify drug-seeking behavior because those individuals should be more likely to overdose. Drug-seeking behaviors and its relationship to opioid overdoses was examined using a dataset generated by the Centers for Health Innovations, which has access to Cerner's Electronic Healthcare Records. The dataset contained over 500,000 patients who received an Oxycodone prescription from 2012 to 2016. The study found that for specific regions in the US, drug-seeking behaviors did increase the chance of overdose. However, the results do not suggest that implementing policies intended to reduce drug-seeking behavior will have a significant effect on the number of opioid overdoses.

Introduction

There has been much concern relating to the prescription of opioid pain relievers in the United States. There were over 14,000 overdoses due to natural and synthetic opioids in 2017 (National, 2017). Policymakers, health professionals, and others are wondering what, if anything, can be done. There have been many suggestions for combating the crisis, one of which is to identify drug-seeking behavior. Both public institutions such as the Centers for Medicare and Medicaid Services (CMS) (OPIOID, 2017) and private sector non-profits such as Kaiser Permanente (DuPont, 2015) have suggested that identifying drug seeking, or 'red flag' behaviors can help doctors reduce the crisis. Drug seekers can be contributing to the crisis in two distinct

ways. The first and the focus of this paper are patients who are addicted to opioids and continue to go to doctors with the hope of getting their next 'fix.' The second is patients that go to doctors with the hope of getting a prescription to resell the pills on the black market. However, only those are trying to use the medication will have adverse outcomes related to the use of the medication which will show up in a dataset comprised of medical records. Thus, the relationship between drug-seeking behavior and its relationship to medication reselling is not considered in this analysis.

In previous research drug seeking definitions vary. For example, while drug seeking is commonly viewed as getting a prescription from a new doctor (DuPont, 2015; OPIOID, 2017), others have suggested that it involves going to an entirely new healthcare facility (Mccaffery, 2005). Still, other studies have suggested behaviors related to changing provider specialty, location or care-setting (Singhal, 2016). This study will combine these definitions and operationalize them in the context of a dataset from electronic healthcare records.

Methods

The data for this project came from the Center for Health Systems Innovation (CHSI), which is partnered with Oklahoma State University's Spears School of Business. CHSI has access to the electronic health records where Cerner's electronic healthcare record (ERH) software was used. Cerner is one of the largest EHR companies in the United States. For reference, Cerner's EHR software is utilized in nearly 25% of all hospitals, meaning that it encompasses a vast amount of healthcare records. The dataset CHSI provided for this research included deidentified healthcare records of all health encounters where patients were prescribed Naloxone or Oxycodone from 2012-2016. The total dataset included over 1.5 million encounters

and over five-hundred and fifty thousand distinct patients who received an Oxycodone prescription.

The data was cleaned using base SAS data steps and procedures such as proc SQL. Because drug-seeking behavior is a pattern of behavior over time, the data had to be agglomerated from the encounter level of analysis to a patient level of analysis. On initial examination, in this dataset, no patient overdosed on more than one encounter, so no conclusions about multiple overdoses could be ascertained. Therefore, all patient encounters after the patient overdosed were dropped from the dataset because data posterior to the prediction event cannot be used after the fact to predict the event.

The determination of an opioid overdose was made using the Center for Disease Control's (CDC's) definition of ICD-9 codes that signify a 'prescription opioid poisoning,' which included 965.00, 965.02, 965.09, E850.1 and E850.2 (Prescription, 2013). If a patient was diagnosed with any of these codes during an encounter, the encounter was considered to contain an overdose. If an encounter included the 977.9 diagnostic code ('unspecified drug overdose') as well as a prescription for naloxone the patient was not assumed to have had an opioid overdose.

To operationalize drug-seeking behavior for this study, the first and broadest variable examined, 'drug seeking physician flag,' was defined as whether a patient received an opioid from two different prescribing doctors on different "health encounters." A "health encounter" is defined as a duration of continuous treatment at the same health facility. However, determining if a patient received a prescription from a different doctor was challenging because a patient can get a prescription from multiple doctors during the same encounter. In the study, a patient was only considered drug seekers if they received prescriptions during a follow-up encounter from doctors who had previously not prescribed the patient Oxycodone.

In addition to that broadest definition, four additional circumstances were considered as potential drug-seeking behavior. Furthermore, the patient could try to get a new prescription from a doctor 1) in a different specialty, 2) at a new healthcare facility, 3) in a new care setting (‘obstetrics,’ ‘dental’), or 4) at a new location (‘inpatient’, ‘outpatient). While patients cannot usually choose whether to be inpatient or outpatient, drug seekers are known to lie about symptoms which may affect where doctors believe they should be treated (Weiner, 2015). Because these variables were all binary, meaning the behavior occurred or didn’t, the number of times the behavior occurred was not considered. Also, note that these variables are colinear but not perfectly collinear. A patient could get a prescription from the same doctor during a follow-up encounter in a different facility when their doctor works at two facilities. The same was true for all the drug-seeking behaviors used; thus interactions between the variables were considered. What this means is that combinations of potential drug-seeking behaviors were examined. For example, the rate of an overdose of patients who got a prescription from a new doctor and got it in a new care-setting can be compared to the rate of an overdose of patients who got a prescription from a new doctor in a new facility, but in the same care-setting.

Finally, 13 control variables were used to determine if the effect of the drug-seeking behavior would be significant when controlling for other factors. The variables were selected because they were available in the dataset and were used in previous studies (Weiner, 2015; Sun, 2017). These control variables included whether the patient went to urban or rural facilities, the patient’s region, race, gender, marital status, insurance company, age, average length of an encounter, the number of Oxycodone prescriptions they received, the total number of Oxycodone pills they took, the total number of milligrams of oxycodone they received, the total number of prescriptions of oxycodone they were given and the total number of days they remained on the

Oxycodone prescription. Because these variables were created for each patient, in the case of two nominal variables, insurance company, and urban or rural status, a patient could have health encounters in both an urban and rural setting or encounters with different insurance companies. In both cases, a new level of the nominal variable was created signifying that the patient had been to both urban and rural settings or the patient used multiple insurance companies. In summary, the finalized dataset then contained the prediction variable (whether a patient overdosed), five different potential drug-seeking behavior variables and 13 control variables.

Descriptive Results

The descriptive statistics related to patient Oxycodone use and overdose rate are in the table below:

Treatment	Overdosed	No Overdose	Percent Overdosed
Oxycodone Prescription	956	554,244	0.17%
No Oxycodone Prescription	2,953	768,118	0.38%

These statistics reveal that even though a huge number of people received an Oxycodone prescription, only .17% overdosed, according to the CDC's definition. Because the cause of the overdoses related to "no prescription" cannot be determined, those outcomes were filtered out in the modeling process.

The next table shows how often patients got more than one prescription and overdosed.

Drug Usage Variables	Number of Unique Patients	Percent Overdosed
1 Oxycodone Prescription	495,852	.14%
> 1 Oxycodone Prescriptions	58,392	.44%
Total Overdoses	956	.31%

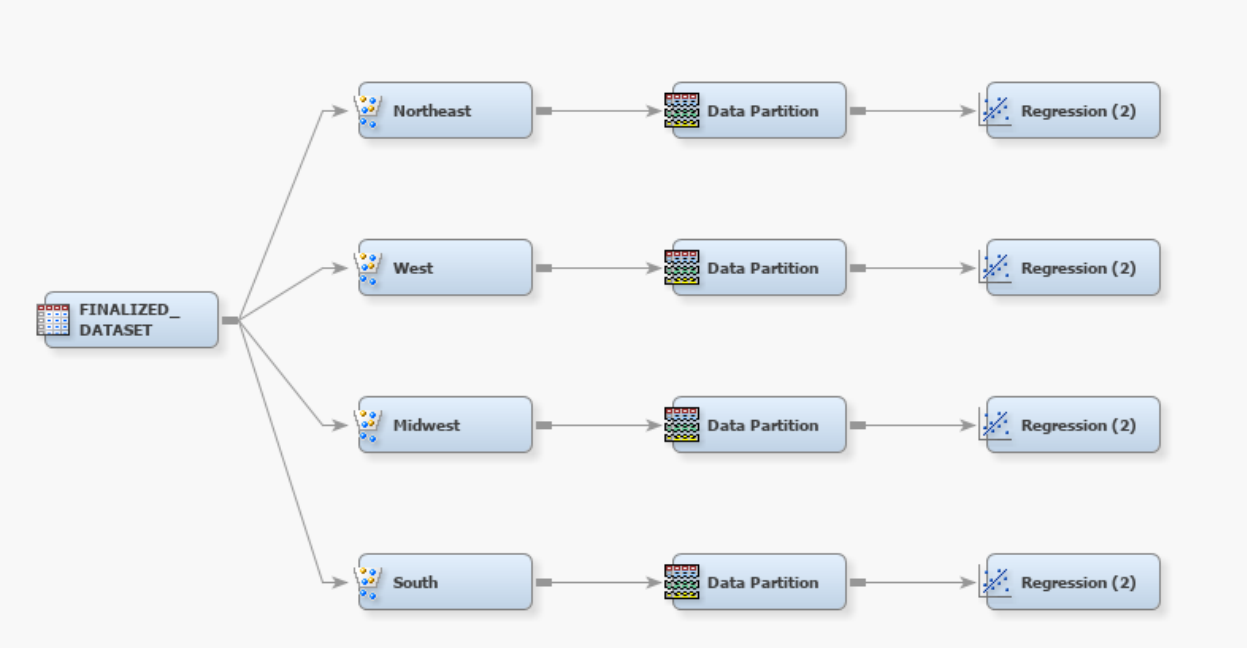
The next set of descriptive statistics shown below show how commonly the different drug seeking variables occurred and the associated percentage of overdoses.

Drug Seeking Variable	Number of Unique Patients	Percent Overdosed
Multiple Physicians	47,232	.30%
Multiple Specialties	33,044	.29%
Multiple Care Settings	26,832	.31%
Multiple Locations	21,668	.30%
Multiple Facilities	2,979	.34%

As this table demonstrates, over 80% of patients who received a second Oxycodone prescription received it from a unique prescribing physician. However, only 5% of patients who got a second opioid prescription did so at a second health facility.

Predictive Results

The drug seeking behaviors and interactions between them were not significant when using a stepwise logistic regression model. However, the drug seeking behaviors did interact with region Using a filter node, models for each region were created yielding the following results:



Region Modeled	Drug Seeking Variable	Odds Ratio Overdose/No Overdose
South	Prescription from Multiple Specialties	7.80
West	Drug-Seeking Variables not Significant	N/A
Midwest	Drug-Seeking Variables not Significant	N/A
Northeast	Prescription from Multiple Locations	2.49

From above, the increase in risk for overdose based on the drug seeking variables created was most apparent in the south, where people who got an Oxycodone prescription from doctors in multiple specialties had almost 8 times the odds of overdosing compared to those who did not.

Below is the classification table from the southern region regression model, which was the only model that could predict overdoses with reasonable sensitivity and without very low precision.

Classification Table

Data Role=TRAIN Target Variable=specific_od_flag Target Label=specific_od_flag

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	99.8915	99.9980	98475	99.8783
1	0	0.1085	90.6780	107	0.1085
0	1	15.3846	0.0020	2	0.0020
1	1	84.6154	9.3220	11	0.0112

Data Role=VALIDATE Target Variable=specific_od_flag Target Label=specific_od_flag

Target	Outcome	Target Percentage	Outcome Percentage	Frequency Count	Total Percentage
0	0	99.8975	99.9980	98475	99.8763
1	0	0.1025	84.1667	101	0.1024
0	1	9.5238	0.0020	2	0.0020
1	1	90.4762	15.8333	19	0.0193

The validation sensitivity of this finding was 15.8% and it was able to predict with 90.4% precision.

Discussion

The research has shown that drug-seeking behaviors are statistically significant predictors of whether a patient will overdose in some regions. That suggests that drug-seeking behaviors may vary by location; drug-seekers in the Northeast may use a different strategy than drug-seekers in the south. Individuals who engage in these drug-seeking behaviors in these regions should be informed of their increased risk of overdosing. The importance of this is that it is likely that some individuals behave the way a drug seeker would, without themselves being a drug seeker. It is plausible that an individual had two separate incidents, one that required inpatient care and one which needed outpatient care, that both warranted the use of the Oxycodone to relieve short-term pain. Such an individual would benefit from knowing their increased risk to decide whether using the medication is worth the risk. The results from the southern region showed promise for predicting drug overdoses as a sensitivity of 15.6% is much better than guessing. However, the data doesn't support the conclusion that reducing the number of people who seek drugs will have a large impact on the number of overdoses. Thus, there needs to be caution when applying these results as the clear majority of people didn't overdose after exhibiting drug-seeking behavior, so restricting these people's access may be harmful if they would benefit from the medication.

Limitations

The current study had many limitations. For example, some people who are drug seekers do not use the medication but rather resell it. These people will exhibit drug-seeking behavior but will not overdose making dampening the relationship between drug-seeking behavior and

overdoses. Furthermore, not all overdoses could be determined. For example, there was no way to determine if a patient overdosed at a health facility, not in Cerner's database.

Furthermore, not all opioid prescriptions were known because patients could have received an opioid in addition to OxyCodone or received an opioid from a doctor not in who doesn't use Cerner's ERH system. Also, null values meant that not all individuals who exhibited drug-seeking behavior could be determined. That problem was largest when creating the variable relating to a new care setting. Due to the high number of null values, it is possible that many more individuals got a prescription from multiple care settings but could not be identified because it was not assumed that a null value meant the patient went to a new care setting.

Finally, the study is limited by the definitions of drug-seeking behavior used. Other literature has suggested additional behaviors that could not be identified in this dataset, such as a patient constantly focusing on medicine during the health visit, a patient claiming they lost a prescription, a patient saying they have allergies to new alternatives to narcotics, a patient exaggerating their pain or a patient using an alias (Vukmir, 2004; Gerhardt, 2004).

Future Research

Drug seeking variables could become more significant if tested with more complete patient histories, including, for example: 1) oxycodone use for a longer duration than the four years considered, 2) use of other types of opioid prescriptions, 3) information from health encounters not in the Cerner database and 4) patients who overdosed and died before they got to a hospital. In addition, the definition for an overdose used in this study was very narrow; in a database with more patients for controls, the definition of overdose might be expanded. Also, some researchers are interested in opioids as a gateway drug and consideration of initial drug

seeking behavior may contribute to such research. Finally, opioids are also related to many other health concerns and it could be that drug seeking behavior increases the chance of other adverse outcomes.

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