

Predictive Modeling of Opioid Prescription Fraud
by Centers for Medicare and Medicaid Services (CMS) Providers
PART 2 SUMMARY

Existing Research Studies

Two existing research studies were identified which are directly relevant to my projects' main goal of developing a predictive model to determine the likelihood of opioid-related fraud being perpetrated by a Medicare Part D Provider. First, the US Department of Health and Human Services Office of Inspector General (HHS-OIG) conducted a study that evaluated the prescription drug events records from 2016 with the goal of protecting beneficiaries from the adverse effect of opioid abuse¹. The study's three main components were: an analysis of opioid dispensation and spending (utilization) across all beneficiaries; individual beneficiary usage accounting for prescription strength and treatment duration; and identification of providers which exhibited extreme prescription patterns.

Key results of this study include that one-third of Medicare Part D beneficiaries received at least one opioid prescription; approximately ½ million beneficiaries received large opioid amounts; and around 400 providers exhibited potentially questionable prescription practices.

The second identified research effort is a CMS developed interactive mapping tool which enables users to perform comparisons of Medicare Part D opioid prescriptions on a national-level scale². The tool allows users to explore claim totals and prescribing rates for both opioid and long-acting opioid prescriptions from 2013 through 2017. Percentage change is also determined and displayed for the entire timeframe to assist in visualization of trends at both the state and county levels.

Although in alignment with the referenced studies, the goal of this project would expand upon scope to include an analysis based on known cases of opioid prescription related fraud. By including this aspect, this project endeavors to establish a predictive capability to actively identify suspect providers.

Initial Exploratory Data Analysis

The Medicare Provider Utilization and Payment Data: Part D Prescriber Summary Tables³ for 2013 through 2017 were downloaded and analyzed utilizing Python within JupyterLabs. The resulting combined dataframe contained 84 source columns / features⁴ with an additional column added during load for calendar year, which is identified in the filename. There exists one record for each provider with a registered NPI for each year within the timeframe publicly available, which results in approximately 5.5 million source records.

Each record contains four categories of data pertaining to the provider within that specified calendar year. These categories include details on the following: provider registration, applicable Medicare Program, prescription drug utilization, and beneficiary demographics / health characteristics.

Some key outcomes of initial exploratory data analysis are:

- Overall Provider Characteristics (Not Opioid Specific)
 - Top 10 States by Number of Providers
 - California has largest number of Medicare Part D Providers (143,640), which is not unexpected due to its large population.
 - Florida ranks #4 (82,214) despite an overall large number of Medicare Recipients and is significantly less than the top 2 (New York and California).
 - Top 10 Provider Specialties
 - Nurse Practitioner was the highest ranked specialty (178,337).
 - Overall top 6 ranked specialties (Nurse Practitioner, Dentist, Internal Medicine, Student in an Organized Health Care Education / Training Program, Family Practice and Physician Assistant) seem reasonable but students ranking of #4 (118,911) is an interesting finding.
 - Drop-off between Physician Assistant (#6 - 104,851) and Emergency Medicine (#7 - 48,943) is quite drastic and surprising.
- Opioid Specific Provider Characteristics
 - Opioid Beneficiary Ratio by State (Number of Opioid Beneficiaries to Total Beneficiaries)
 - Top 5 ranking of Alabama, Arkansas, Tennessee, Mississippi, Oklahoma all coincide with the 2017 HHS-OIG Study, although the order varies slightly.
 - New York and Hawaii ranked as two of the bottom three also coincides with the 2017 HHS-OIG Study (Puerto Rico was included in my analysis but may have been excluded from the HHS-OIG Study).
 - Opioid Beneficiary Ratio by Provider Specialty
 - Although Specialist/Technologist Cardiovascular has highest ratio (0.916667), the calculation is based on a very small beneficiary total (12).
 - Interventional Pain Management (0.786231) and Pain Management (0.768426) seem reasonable rankings as the top 2 with large beneficiary base (2,524,681 and 2,301,019 respectively).
 - Out of the top 25 identified specialties which had opioid beneficiaries, the difference between Thoracic Surgery (#25 - 0.419788) and Interventional Pain Management (#2 - 0.786231) appear quite drastic (0.366443).
- High-level Opioid-Specific Claims / Beneficiary Analysis
 - National Part D Beneficiary Totals / Trends
 - Total beneficiaries experienced a fairly steady climb throughout the timeframe.
 - Beneficiaries receiving opioids rose until a peak in 2015 and then declined to a similar number occurring in 2013.
 - Beneficiaries receiving long-active opioids was fairly flat until 2015 and then declined at a steady rate.
 - Rate at which total beneficiaries change slightly from 2013 to 2017 but continually increased.
 - Rate at which beneficiaries received opioids declined steadily from 2013 to 2017.
 - Rate at which beneficiaries received long-acting opioids slowed from 2013 to 2015 and then drastically declined from 2015 to 2017.

- National Part D Claim Totals / Trends
 - Total claims experienced a fairly steady climb throughout the timeframe (similar to beneficiary totals).
 - Claims including opioids increased until 2014 and then slowly declined (peak occurred one year earlier than beneficiary totals).
 - Claims including long-active opioids was fairly flat until 2015 and then declined (similar to beneficiary totals).
 - Rate at which total claims increased followed a similar pattern as beneficiary totals but at lower percentages.
 - Rate at which opioid-related claims changed did not follow a similar pattern as the beneficiary totals, with a dip 2015, followed by an increase in 2016 and then a sharp decline.
 - Rate at which long-acting opioid-related claims changed followed a similar pattern as beneficiary totals but at slightly lower rates.
- Opioid and Long-acting Opioid Prescriber Rate Histogram
 - Provider prescriber rate for opioids demonstrates highest totals around 5% and then drops off sharply until around 15% before a steady decline.
 - Provider prescriber rate for long-acting opioids demonstrates highest totals around 10% and then slowly drops off until around 50% before a steady decline.
- Opioid and Long-acting Opioid Prescriber Cost Analysis
 - (Average Opioid Cost = Total Opioid Drug Cost / Total Opioid Claims) on a provider basis
 - Of the top 50 providers with highest average opioid cost (range of 1380.62 - 5778.87) the most frequent specialties were Internal Medicine (20%), Nurse Practitioner (16%), Hematology/Oncology (16%), and Radiation Oncology (12%).
 - (Average Long-Acting Opioid Cost = Total Long-Acting Opioid Drug Cost / Total Long-Acting Opioid Claims) on a provider basis.
 - Of the top 50 providers with highest average opioid cost (range of 2239.12 - 7610.47) the most frequent specialties were Internal Medicine (30%), Family Practice (18%), Nurse Practitioner (14%), Physical Medicine and Rehabilitation (6%), and Hematology/Oncology (6%).
 - Family Practice exhibited a large increase from 8% for opioid to 18% for long-acting opioids.

References

¹ HHS-OIG, *Opioids in Medicare Part D: Concerns about Extreme Use and Questionable Prescribing*, OEI-02-17-00250, July 2017. Retrieved from <https://oig.hhs.gov/oei/reports/oei-02-17-00250.asp> on 2020-02-24.

² CMS, Medicare Part D Opioid Prescribing Mapping Tool / Methodology, April 2019. Retrieved from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Downloads/Opioid_Methodology.pdf on 2020-02-24.

³ CMS, Medicare Provider Utilization and Payment Data: Part D Prescriber Summary Tables available at <https://data.cms.gov/browse?category=Medicare+-+Part+D&sortBy=alpha&tags=provider+summary&utf8=%E2%9C%93>

⁴ CMS, Medicare Fee-For Service Provider Utilization & Payment Data Part D Prescriber Public Use File: A Methodological Overview, April 2019. Retrieved from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Downloads/Prescriber_Methods.pdf on 2020-02-20.