Opioid Prescribing Patterns by Drug Type: The Pennsylvania Experience

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Abstract

Background: Opioid abuse persists as a significant public health issue in the United States; many states are implementing education and monitoring programs in response. This study examined opioid prescribing patterns and trends after implementing a prescription drug monitoring program in Pennsylvania from 2016 to 2020.

Methods: A cross-sectional data analysis using de-identified data from Pennsylvania's PDMP delivered by the Pennsylvania Department of Health was undertaken.

Results: In 2016, nearly 2 million opioid prescriptions were given to patients across the state. However, by the end of the study period in 2020, there was a 38% decrease in opioid prescriptions written. Specifically, over 700,000 fewer prescriptions in the first quarter of 2020 compared to the third quarter in 2016. The opioids that were most frequently prescribed were oxycodone, hydrocodone, and morphine.

Conclusion: While fewer prescriptions were being prescribed overall, the breakdown of drug type being prescribed remained similar in 2020 compared to 2016. Fentanyl and hydrocodone saw the largest decrease between 2016 and 2020.

Background

The “opioid epidemic” remains an ongoing problem in the United States. From 1999–2018, nearly 450,000 people have died from an overdose involving opioids, including prescription and illicit opioids (1). In 2018, nearly 70% of all overdose deaths involved an opioid (2). Nevertheless, opioid prescribing increased 350%, from 180 to 640 morphine milligram equivalents per capita, during 1999–2015 (3). Similarly, the national rate of drug overdose deaths increased from 6.1 per 100,000 people in 1999 to 21.7 in 2017 (4).

One of the most common sources of opioids remain prescription opioids from physicians and other prescribers (5). Nationally, medical providers prescribed 72.4 opioid prescriptions per 100 people in 2006; this number increased to nearly 85 prescriptions per 100 people by 2010 (6). However, strategies involving education and monitoring programs have been implemented that have shown promise in decreasing opioid prescriptions (7–9). One such program is the Prescription Drug Monitoring Program (PDMP). State PDMPs generally have two functions. First, to increase patient care quality by providing prescribers access to a patient's controlled substance history to make informed prescribing decisions. Second, to assist regulatory and law enforcement agencies in identifying and preventing fraud, drug abuse, and the illegal distribution of controlled substances. Several studies have found that PDMPs, despite their large variations, have been associated with reductions in prescription opioids, opioid diversion, and misuse of prescription opioids (7–9). Similarly, PDMP studies have shown that nationally the top opioids prescribed are hydrocodone, oxycodone, oxymorphone, morphine, codeine, and fentanyl (10).

Pennsylvania passed legislation to implement a statewide PDMP in 2014, which eventually went live in 2016. The Pennsylvania Department of Health runs the PDMP. Pennsylvania requires all licensed prescribers to register with the PDMP and reference it before prescribing opioids. To better understand the effect of the PDMP on opioid prescribing patterns, this study was performed on Pennsylvania's PDMP to determine opioid prescribing patterns after implementation of a new PDMP.

Methods

After institutional review board approval, a cross-sectional data analysis using de-identified data from Pennsylvania's PDMP delivered by the Pennsylvania's Department of Health was undertaken. The Pennsylvania PDMP collects information on all filled prescriptions for controlled substances.

Any prescriber that Pennsylvania lawfully authorizes to distribute, dispense or administer a controlled substance, other drugs, or device in the course of professional practice or research is required to register with the PDMP. Prescribers and their delegates will have access to the data stored by the PDMP at any given time and check the PDMP each time they prescribe a controlled substance. The Pennsylvania PDMP monitors all controlled substances, monitoring Schedule II through Schedule V controlled substances.

Study data included opioid supply, quantity, partial fill, and authorized refill count.

Data was compared between two quarters (Q), Q3 of 2016 and Q1 of 2020. These were selected for analysis because Q3 of 2016 was the first quarter where the PDMP was fully operational and Q1 of 2020 was selected because it was the most recent quarter with data prior to the COVID-19 pandemic. Differences and percent changes were used to assess how the number of opioid prescriptions changed. The data was also broken down for each specific opioid per quarter to assess the differences over time. All statistical analyses were done using Microsoft Excel (Version 16.43).

Results

The total number of prescriptions prescribed in Q3 2016 was 1,941,404, and the total number of prescriptions prescribed in Q1 2020 was 1,197,959. This 38% decrease from 2016 to 2020 represents 743,445 fewer prescriptions prescribed between these two quarters. (Table 1, Fig. 1) Beginning with Q3 2016, each subsequent quarter saw fewer opioids prescribed, decreasing on average by $3.4\% \pm 1.7\%$ through Q1 2020. (Fig. 2)

Table 1
Specific opioid type, amount, and percent change

Opioid Type	Q3 2016	Q1 2020	Difference	Percent change
CODEINE	1,114	754	360	32%
FENTANYL	85,006	41,322	43,684	51%
HYDROCODONE	662,695	366,966	295,729	45%
HYDROMORPHONE	32,421	23,456	8,965	28%
MEPERIDINE	949	107	842	89%
METHADONE	28,414	17,408	11,006	39%
MORPHINE	135,983	105,668	30,315	22%
OXYCODONE	961,172	630,888	330,284	34%
OXYMORPHONE	23,840	5,533	18,307	77%
TAPENTADOL	9,498	5,498	4,000	42%
OTHER	1258	466	792	63%
Table 1. Prescription numbers by opioid type in Q3 versus Q1 2020. (OTHER: represents all opioids cumulatively that were prescribed less than 500 times; and includes, belladonna opium, levorphanol, and susfentanil).				

Relative to opioid types prescribed, Table 1 shows each of the ten different opioids categories, their amounts in Q3 2016 and Q1 2020, and their changes in absolute number and percentage. Figure 3 depicts each of the ten different opioids, comparing them within the year. Hydrocodone and oxycodone had the largest absolute decrease in the number of prescriptions from 2016 to 2020 by 295,729 and 330,284, respectively.

When looking at the percent change of prescriptions, it was observed that meperidine had the largest decrease at 89%. It was also observed that fentanyl, oxymorphone, and the “other” category (belladonna, levorphanol, and susfentanil) had the largest decrease in percentage, decreasing by 51%, 77%, and 63%, respectively. Figure 4 illustrates 2016 and 2020 as percentages and shows the percentage break down of opioids each year.

When comparing the percent composition between Q3 2016 and Q1 2020 (Table 2), it was observed that five of the thirteen opioids increased. Morphine and oxycodone saw the largest increase among the opioids, increasing by 1.82% and 3.15%, respectively. Fentanyl and hydrocodone were the two opioids that saw the largest decrease between 2016 and 2020, decreasing by .9% and 3.2%, respectively.

Table 2
Percent composition of individual opioids

Opioid Type	Q3 2016	Q1 2020	Difference
CODEINE	0.06%	0.06%	-0.01%
FENTANYL	4.38%	3.45%	0.93%
HYDROCODONE	34.13%	30.63%	3.50%
HYDROMORPHONE	1.67%	1.96%	-0.29%
MEPERIDINE	0.05%	0.01%	0.04%
METHADONE	1.46%	1.45%	0.01%
MORPHINE	7.00%	8.82%	-1.82%
OXYCODONE	49.51%	52.66%	-3.15%
OXYMORPHONE	1.23%	0.46%	0.77%
TAPENTADOL	0.49%	0.46%	0.03%
Other	0.02%	0.03%	-0.01%
Table 2. Percent composition each opioid has in the total amount in Q3 2016 and Q1 2020. (OTHER: represents all opioids cumulatively that were prescribed less than 500 times; and includes, belladonna opium, levorphanol, and susfentanil).			

Discussion

This study aimed to examine the opioid prescribing patterns and trends relative to the newly implemented PDMP in Pennsylvania. This study found that from Q3 in 2016 to Q1 in 2020, there was a 38% decrease in opioid prescriptions. Hydrocodone and oxycodone had the largest decrease in the number of prescriptions, decreasing from 2016 to 2020 by 295,729 and 330,284, respectively. Fentanyl, meperidine, and oxymorphone had the largest decrease in percentage, decreasing by 51%, 89%, and 77%, respectively. The composition of drugs being prescribed saw slight changes from 2016 to 2020. Fentanyl and hydrocodone were the two opioids that saw the largest decrease between 2016 and 2020 but decreasing by only 0.9% and 3.5%, respectively. Morphine and oxycodone saw the largest increase among the opioids, increasing by 1.8% and 3.2%, respectively.

This study is one of the first to examine Pennsylvania's opioid prescribing trends. Pennsylvania is a large, diverse state with one of the largest cities in the country in Philadelphia, several other large metropolitan areas, and large rural areas. National trends show the total number of prescriptions dispensed peaked in 2012, at more than 255 million and a dispensing rate of 81.3 prescriptions per 100 persons. While opioid prescriptions have decreased to 153 million, dispensing at 46.7 prescriptions per 100 persons nationally, they are still being prescribed almost three times more than in 1999 (11, 12). Pennsylvanians similarly continue to receive a high number of opioid prescriptions, but there is a downward trajectory demonstrated in the four years since PDMP data has become available.

In addition to the decrease noted in the number of opioid prescriptions written across Pennsylvania during the study period after implementing the PDMP, there are also some interesting findings about the type of opioids being prescribed. Specifically, Pennsylvania prescribers decreased their overall opioid prescription numbers; the greatest decrease was among opioids with the highest morphine milligram equivalents (MME). For instance, while hydrocodone and oxycodone had the largest absolute decrease in the number of prescriptions over the study period, fentanyl, meperidine, and oxymorphone had the largest decreases percentage-wise. These three medications also happen to have the highest MME.

Upon review of the current literature, no other studies were identified that examined opioid prescribing patterns at a state level. However, one study was identified that evaluated Texas' opioid prescribing patterns that reported a reduction in schedule II medications being prescribed and an increase in schedule IV medications like tramadol (13). While this cannot be directly compared to the Pennsylvania PDMP because it does not record schedule IV medications like tramadol, it is speculated that tramadol would similarly have increased over the study period in Pennsylvania.

The decrease in opioid prescriptions from 2016 to 2020 saw higher MME opioids being prescribed less. Nevertheless, when looking at each quarter and its composition of opioids being prescribed, only slight changes were seen from 2016 to 2020. Fentanyl and hydrocodone saw the largest decrease, 0.9% and 3.5%, respectively. Morphine and oxycodone saw the largest increase, 1.8% and 3.2%, respectively. While the percent composition of medications remained relatively consistent from quarter to quarter, the total number of prescriptions decreased. When this article was written, no previous research that evaluated the composition of opioids being prescribed had been published. While a firm conclusion cannot be drawn about what is responsible for the decreased opioid prescriptions, the Pennsylvania PDMP could be anticipated to have played a role in helping prescribers make informed decisions regarding patients resulting in decreased opioid prescriptions.

While the PDMP allows better tracking of opioids and, at least in Pennsylvania, documents a decreasing trend in prescribing, Finley et al. found that studies examining the association between PDMP implementation and opioid-related outcomes did not display a constant pattern (14). When Florida and New York evaluated their PDMPs, they found evidence that opioid prescribing was reduced (15, 16). Pennsylvania aligns with Florida and New York in their reduction of opioid prescribing. However, when North Carolina analyzed their prescribing results, they found no significant trends in opioid prescribing (17). The variation between these states could be from the variation in study design and methods. However, another factor that could have affected these results is that PDMPs vary considerably between states. Specifically, each state PDMP program is managed by varying regulatory agencies, collects different data types, requires data to be updated at different times, allows access to different groups of people, and does not require all prescribers to register and use the PDMP.

While the implementation of the PDMP has allowed for better tracking of opioid prescriptions, Pennsylvania continues to suffer from being the third-highest age-adjusted state for drug overdose death, with a rate of 36.1 per 100,000 standard population, only behind Delaware and Maryland (4). Pennsylvania is also classified as a problematic state because of lower numbers of opioid treatment programs (18). While the evaluation of PDMPs is still in an early stage, the current evidence has shown that PDMPs may have other unintended consequences. First, PDMPs are serving as a more comprehensive tool for prescribers; Feldman et al. found that 93.6% of physicians that accessed Ohio's PDMP reported it influenced the type and quantity of medication they prescribed (19). Another reported PDMP outcome is that it may cause a "chilling effect," dissuading prescribers from prescribing opioids that might deny patients adequate pain control (20, 21), or other unclear long-term unintended consequences (14, 22). Some evidence also suggests that patients with reduced access to opioids may turn to illegal options like heroin; two studies found an increase in mortality from heroin, morphine, and fentanyl in some states with PDMPs (15,23).

This study had several limitations. First, patient and provider demographic data was not available for review and correlation. Therefore, a sub-analysis based on patient age, gender, race, and other demographics was impossible. Similarly, no prescriber data was available, and therefore no analysis of prescriber characteristics, including specialization and training, was not possible. Lastly, this study represents a specific period in time of analysis without control for other variables, and therefore conclusions on opioid prescribing characteristics can only be related to the state's PDMP, but direct causality cannot be proven.

Conclusion

This study revealed that opioid prescribing in Pennsylvania is trending downward since its implementation of its PDMP. Expressly, a 38% decrease in opioid prescriptions was noted between the quarters of analysis – Q3 2016 and Q1 2020. Moreover, a quarter-over-quarter decrease in opioid prescriptions of 3.4% was also noted. Although the make-up of which opioids are being prescribed has remained consistent, a greater decrease in high MME opioid prescriptions was noted. Additional research is needed to determine the ongoing efficacy of the PDMP with control for opioid types, patient demographics, prescriber characteristics, and correlation to opioid-related deaths. In addition, greater patient, prescriber, and community programs should be considered to address the opioid epidemic comprehensively.

Abbreviations

Prescription drug monitoring program (PDMP), morphine milligram equivalents (MME)

Declarations

Ethics approval:

This study conducted all analysis on deidentified data obtained from Pennsylvania's department of health. The institutional Review Board at Rothman Orthopaedic Institute approved a standardized protocol.

Consent for publication:

Not applicable

Availability of data and materials:

The data that support the findings of this study are

available from Pennsylvania's Department of Health but restrictions apply to the availability of

these data, which were used under special permissions for the current study, and so are not

publicly available.

Competing interests:

None of the authors or their family members have conflicts of interest

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Authors' contributions:

BB was a major contributor to the writing of the manuscript

CM obtained the data from the department of health

MS was a major contributor in the data analysis

AI was a major contributor in the writing of the manuscript

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References

1. Centers for Disease Control. Wide-ranging online data for epidemiologic research (WONDER). 2020; Available at: <http://wonder.cdc.gov>. Accessed 12/3/, 2020.
2. Wilson N, Kariisa M, Seth P, Smith 4, Herschel, Davis NL. Drug and Opioid-Involved Overdose Deaths - United States, 2017–2018. MMWR. Morbidity and mortality weekly report 2020 Mar 20;69(11):290–297. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7739981/>
3. Guy GP, Zhang K, Bohm MK, Losby J, Lewis B, Young R, et al. Vital Signs: Changes in Opioid Prescribing in the United States, 2006–2015. MMWR. Morbidity and mortality weekly report 2017 Jul 7;66(26):697–704. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5726238/>
4. Hedegaard H, Miniño A, Warner M. Drug Overdose Deaths in the United States, 1999–2018. NCHS Data Brief 2020 Jan,. <https://www.cdc.gov/nchs/data/databriefs/db356-h.pdf>
5. Preuss CV, Kalava A, King KC. Prescription of Controlled Substances: Benefits and Risks. StatPearls Treasure Island (FL): StatPearls Publishing LLC; 2020. <https://www.ncbi.nlm.nih.gov/books/NBK537318/>
6. Centers for Disease Control and Prevention. 2018 Annual Surveillance Report of Drug Related Risks and Outcomes. 2018. <https://www.cdc.gov/drugoverdose/pdf/pubs/2018-cdc-drug-surveillance-report.pdf>

- ## Figures

Figure 1

Shows the number and type of opioid prescribed in Q1 2020 versus Q3 2016

Figure 2

Shows the decrease in opioids over time after the start of the PDMP

Figure 3

Compares the thirteen different opioid amounts that were prescribed in 2020 and 2016

Figure 4

Represents the total number of opioids prescribed in 2016 and 2020 as a percent, the other category is comprised of Tapentadol, Susfentanil, Oxymorphone, Methadone, Meperidine, Levorphanol, Hydrocodone, Codeine, and Belladonna-opium