

Changes in Morphine Distribution in the United States

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Abstract

Background: Morphine is one of the most commonly prescribed opioids by hospitals and pharmacies in the United States (U.S.). Morphine's potent analgesic properties have also been associated with the increase in addiction, misuse, and opioid-related deaths in the U.S. since the 1990s. This has led to heavier regulation of opioid usage and prescription within the past decade. Despite federal regulations, population-adjusted morphine distribution varies markedly between states, in part due to varying state laws. The objective of this study was to describe trends in morphine distribution amounts nationwide and between states from 2012 to 2019.

Methods: Drug weight and population data were obtained from Report 5 of the U.S. Drug Enforcement Administration's Automation of Reports and Consolidated Orders System (ARCOS) to describe trends in the distribution of morphine across the U.S. between 2012 and 2019. Morphine distribution amounts were separated by state and business type and adjusted by total grams distributed to each state business by the population of the state. The percent change in grams of morphine distributed per state population from 2012 to 2019 was then calculated.

Results: In 2012, U.S. pharmacies and hospitals dispensed 24,600 kilograms of morphine. In 2019, that number had decreased to 11,900 kilograms, a 51.7% decrease. Notably, Oregon experienced the largest decrease, 68.2%. States with the highest morphine usage in 2012 also observed the highest declines in morphine distribution amounts over the 7 years.

Conclusion: Distribution of morphine has substantially decreased in the last decade. This is observed nationally and unanimously statewide. The decline in the distribution of morphine in the U.S. may be attributable to increased prioritization of the opioid crisis as a public concern, resulting in increased funding of opioid misuse and treatment programs and decreased production quotas for opioids, including morphine. This decline also coincides with the national shortage of parenteral opioids resulting in greater prescriptions of alternative opioids such as nalbuphine and buprenorphine. Guidelines may also be effective in changing prescribing practices and can be considered when comparing differences in decline of morphine distribution between states. The Oregon Health Authority (OHA) implemented an Opioid Initiative in 2015 that increased access to nonopioid pain treatment, decreased opioid prescribing, and used data to inform policies and interventions. This coincides with Oregon having the greatest decrease in morphine prescriptions compared to all other states.

Introduction

Since the federal deregulatory policies of the late 1980s that gave pharmaceutical companies greater direct-to-consumer marketing access, the United States (U.S.) has observed an increase in demand and prescription rates of opioids. This is partially attributable to aggressive advertising of opioids that were oftentimes misleading and labeled opioids as non-addictive (1). The ongoing opioid crisis due to the subsequent rise in opioid addiction and misuse was declared a national public health emergency in 2017.

Morphine, a potent analgesic commonly prescribed for around-the-clock treatment of moderate to severe pain, is one of the most commonly abused opioids in the U.S. Adverse effects of morphine range from increased risk of infections to neonatal abstinence syndrome to death. Treating opioid abuse is estimated to cost \$72 billion each year, comparable to medical costs for treating asthma and diabetes (2). Morphine is most frequently prescribed for chronic, postoperative, and acute outpatient pain. Prescriptions increased by 64% between 2004 and 2011 — the greatest increase observed across all opioid analgesic prescriptions — but after peaking in 2012 has since declined (3). This coincides with the U.S. Department of Health and Human Services' \$1 billion fund allocated to states to be used for addiction prevention, treatment, and recovery services, data collection, pain management, overdose reversing drugs such as naloxone, and research. Usage of these funds has largely lied within individual state legislation (4).

Despite an overall national decrease in morphine prescriptions, there is marked variation between states concerning the percent change in population-adjusted opioid distribution since the peak of the opioid crisis in 2012. Therefore, the objective of this report is to 1) describe trends in morphine prescription from 2012 to 2019 and 2) compare these trends on a state-to-state basis.

Methods

Procedures

All data was collected through the Automation of Reports and Consolidated Orders System (ARCOS). ARCOS is an automated, comprehensive drug reporting system that allows the U.S. Drug Enforcement Administration to monitor the flow of controlled substances from the point of manufacture through commercial distribution channels to point of sale or distribution at the dispensing/retail level — hospitals, retail pharmacies, practitioners, mid-level practitioners, and teaching institutions (5). ARCOS tracks controlled substances transactions and

monitors the distribution of controlled substances by weight (grams). The analysis for this study was for morphine distributed to pharmacies and hospitals from 2010 to 2019. The total grams per year per state and dispenser/retailer was accessed through the publicly available ARCOS Report 5.

Analysis

The programs GraphPad Prism, Microsoft Excel, and JMP were used to graph and analyze the data. The weight (g) contributed by practitioners, mid-level practitioners, and teaching institutions was negligible in comparison to hospital and pharmacy weight (g). We added pharmacy and hospital weights of morphine for each year per state and divided them by the population of the state for a population adjusted calculation for 2012, which was the peak year of total morphine prescribed, and 2019. Population information for 2012 and 2019 was obtained from the U.S. Census Bureau. Then, the percent change between 2012 and 2019 was calculated for each state using their respective population adjusted weights. Statistical significance of the percent change for each state was determined using a 95% confidence interval, which was calculated as 1.96 times the standard deviation from the national average in the U.S., calculated by taking the average of all percent changes. This study was approved by the Institutional Review Boards of Geisinger and the University of New England.

Results

The peak year for total morphine distributed between 2010 and 2019 was 2012, during which hospitals and pharmacies dispensed 24,166,070.11 grams, compared to 11,946,706.94 grams in 2019 (Figure 1).

Hospital and pharmacy opioid distribution were broken down by state, by the morphine weight distributed per person by each state's population (Figure 2). When comparing 2012 and 2019, several changes were notable. Firstly, between the peak year of 2012 and 2019, hospital and pharmacy distribution of morphine declined by 51.7% nationally. Secondly, in 2012, the states prescribing the most morphine, Tennessee (18,016.36 grams/100K), Oregon (15,480.77 grams/100K), and Arizona (15,330.38 grams/100K) saw some of the largest decreases in prescription between 2012 and 2019; Tennessee had a 61.6% reduction, Oregon had a 68.2% decline, and Arizona had a 65.6% reduction. Thirdly, in 2012, the state of Oregon was prescribing 15,480.78 grams/100K of morphine; in 2019, that number had dropped to 4,924.88 grams/100K — a 68% decrease, which is statistically significant and the largest decrease in the U.S. for morphine prescription between 2012 and 2019. The state with the smallest reduction in morphine

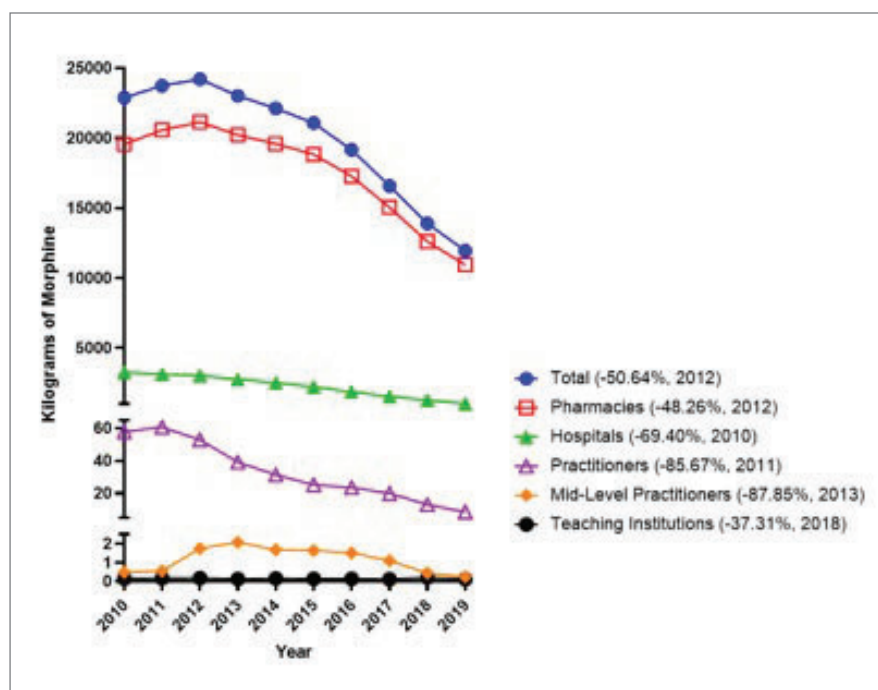


Figure 1. Amount of morphine in kilograms distributed to different business types from 2012 to 2019, as reported by the Drug Enforcement Administration's Automated Reports and Consolidated Ordering System (ARCOS). The percent change relative to the peak year is shown in parentheses.

prescription, Illinois, dispensed 3,994.72 grams/100K in 2012 and 2,634.47 grams/100K in 2019 — a statistically significant decrease of 34.1%.

Discussion

This study identified two key findings about the use of morphine in the U.S. in the past decade. First, total morphine prescriptions from hospitals and pharmacies across the U.S. substantially decreased by 51.7% since peaking in 2012. However, the size of this reduction varied across the 50 states, with an approximately two-fold difference between the largest percent decrease in morphine prescriptions (−68.19%) seen in Oregon from 2012 to 2019, and the smallest percent decrease (−34.05%) seen in Illinois within the same time period.

The overall reduction in morphine prescriptions nationally can be attributed to more aggressive and comprehensive policies and initiatives prioritizing the opioid crisis as a healthcare issue. The US Drug Enforcement Administration (DEA) decreased quotas after the passage of the SUPPORT Act, which called on the DEA to quantify diversion of prescription opioids and “make appropriate quota reductions” (6). In 2012, the DEA quota for morphine production (for sale) was 48,200,000 grams; this was decreased by 39% to 29,353,655 in 2019 (7, 8). Interestingly, this reduction in the overall production quotas of opioids is concurrent with the rise in the production of marijuana (6). Indeed, another factor contributing to the decline in morphine prescriptions may be the nationwide shortage of parenteral opioids (notably morphine, hydromorphone, and fentanyl) that has resulted in diversion to alternative opioids such as nalbuphine and buprenorphine (9).

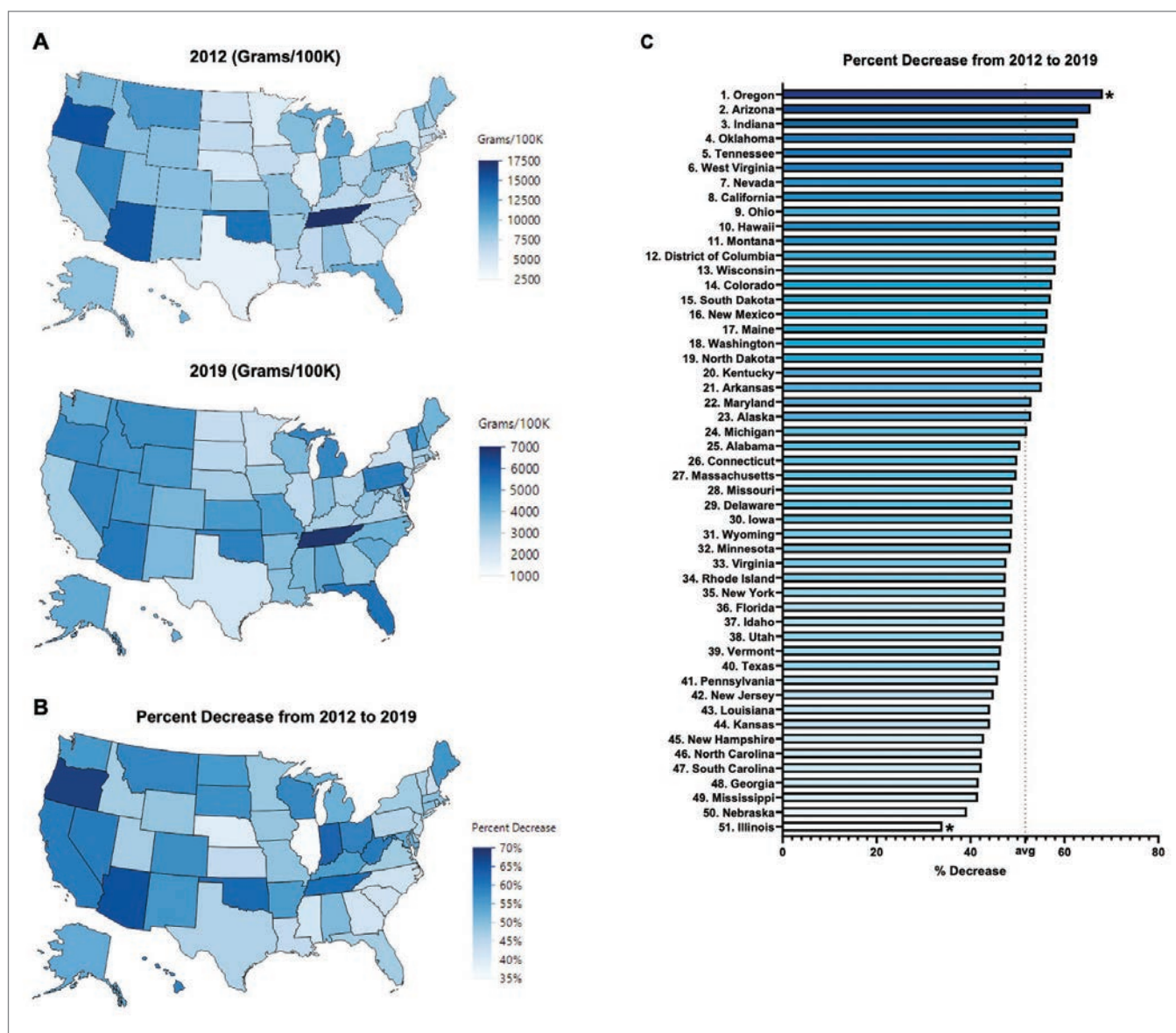


Figure 2. (A) Hospital- and pharmacy-distributed morphine in grams per person per state in 2012 and 2019 as reported by the Drug Enforcement Administration's Automated Reports and Consolidated Ordering System (ARCOS). (B and C) Percent decrease from 2012 to 2019 in A. Average decrease was -51.66%. *State values that were outside a 95% confidence interval, calculated as mean $\pm$ (1.96 x standard deviation), namely those of Oregon and Illinois, were considered statistically significant.

The variability among different states with regard to their success in reducing morphine prescriptions may be attributable to differences in state policies in handling the opioid crisis. In 2019, pharmacies and hospitals in Texas distributed 2116.52 grams/100K of morphine, the smallest population-adjusted amount out of all 50 states excluding Washington D.C. The decline in Texas' prescription rates of morphine and all other opioids in general have been attributed to the implementation of several state policies, including the "pill mill" law passed in 2010 that led to significant decreases in monthly morphine prescription volume (10). Oregon is another example of a state in which morphine prescriptions have been reduced through policy efforts. The Oregon Health Authority launched The Opioid Initiative in 2015, which works to increase access to nonopioid pain treatment, support medication-assisted

treatment and naloxone access for those using opioids, decrease opioid prescribing, and use data to inform policies and interventions. From 2015 to 2017, the number of Oregonians on 90 or more morphine equivalent doses (MEDs) decreased by 37%, from 11.1 per 1,000 residents quarterly to 7.0 per 1,000 residents quarterly. Prescription opioid overdose deaths decreased 20% from 4.5 per 100,000 in 2015 to 3.6 per 100,000 in 2016 (11). Policies limiting opioid prescriptions (regulations for prescribing to "high-risk" Medicaid payers, required urine drugs tests and documentation of justification for high-dose opioid prescriptions) may account for the success of Oregon's Opioid Initiative, especially as 4.1% of all prescribers were responsible for 60% of controlled substance prescriptions in Oregon (2).

A strength of this study was that it consolidated both hospital and pharmacy morphine distributions. This controls for potential inconsistencies in defining “hospital” vs “pharmacy” prescribed opioids, as postoperative morphine prescriptions that are written in a hospital but filled in an outside pharmacy are considered “pharmacy-distributed” by ARCOS. A potential limitation of this study is that the drug distribution amounts are listed in weight (grams) rather than number of prescriptions.

Future directions for this analysis can include further investigation of the differences that may result in state-by-state variation, i.e., availability of morphine (including brand and generic manufacturers for both oral and IV morphine) and reliance on opioid adjuncts in each state. Characterization of the primary patient populations that are prescribed morphine in each state, as rural residents and Medicaid payers are associated with higher rates of morphine prescriptions and adverse effects of morphine usage (12).

In conclusion, this study was conducted to observe the national and state-by-state changes in morphine prescriptions by pharmacies and hospitals in the U.S. from 2012, the peak of the opioid crisis, to 2019, the most recent year with completed ARCOS data. Since 2012, morphine prescriptions have decreased in every state, although states with higher morphine distribution in 2012 were observed to have more dramatic decreases in morphine distribution over the 7-year period.

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