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DOI: 10.1377/hlthaff.2015.1661
HEALTH AFFAIRS 35,
NO. 7 (2016): 1230–1236

Medical Marijuana Laws Reduce Prescription Medication Use In Medicare Part D

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ABSTRACT Legalization of medical marijuana has been one of the most controversial areas of state policy change over the past twenty years. However, little is known about whether medical marijuana is being used clinically to any significant degree. Using data on all prescriptions filled by Medicare Part D enrollees from 2010 to 2013, we found that the use of prescription drugs for which marijuana could serve as a clinical alternative fell significantly, once a medical marijuana law was implemented. National overall reductions in Medicare program and enrollee spending when states implemented medical marijuana laws were estimated to be $165.2 million per year in 2013. The availability of medical marijuana has a significant effect on prescribing patterns and spending in Medicare Part D.

In the past twenty years, the drive in many states to legalize medical marijuana has gained widespread public attention, though there has been no corresponding change to federal marijuana laws. In the late 1980s evidence began to emerge that the use of marijuana has a positive effect on the lives of many people suffering from a variety of ailments. Nevertheless, marijuana is still federally classified as a Schedule I drug (the most restrictive category, according to the Controlled Substances Act of 1970), which means that it is deemed to have "no currently acceptable medical use in treatment in the United States," a high potential for abuse, and "a lack of accepted safety for use…under medical supervision."[1(p40)] This classification imposes significant barriers not only to obtaining marijuana products for clinical use but also to conducting primary research on the pharmacological and behavioral impacts of marijuana use.

Despite such barriers, twenty-four states and the District of Columbia have adopted laws legalizing the use of marijuana for medical purposes. Surprisingly, although there is a rapidly growing literature about many indirect effects of medical marijuana laws, almost nothing is known about how these state health policies affect clinical care or spending in the health care sector. In this article we investigate how implementing state-level medical marijuana laws changes prescribing patterns and program and patient expenditures in Medicare Part D for prescription drugs approved by the Food and Drug Administration (FDA).

There is significant variation across state medical marijuana policies.[2] Every state that currently allows the use of medical marijuana requires a licensed physician to recommend that use and requires that the recommendation be made only if a patient presents with one or more illnesses from a state-approved list.[3] Home cultivation of marijuana is sometimes permitted, though every state that passed a medical marijuana law since 2009 has included some form of regulated dispensary program.[1] Some states allow caregivers to distribute marijuana.[1,4] In addition, the legal possession limit differs greatly across states.[5]

The findings from research on the effects of the medical use of marijuana have been extremely mixed. Historically, opponents of medical marijuana legalization have cited addiction, criminal

activity, marijuana's status as a so-called gateway drug, and marijuana's lack of demonstrated medical value as reasons for keeping the drug illegal.[5] However, the causal link between the use of marijuana and the use of harder drugs has never been proven definitively, nor has the link between medical marijuana and criminal activity.

In a 2013 study Mark Anderson and coauthors reported that traffic fatalities dropped 8–11 percent following the passage of state medical marijuana legislation.[6] Sarah Lynne-Landsman and coauthors analyzed data from the Youth Risk Behavior Survey using a difference-in-differences design to estimate the effects of medical marijuana laws on adolescent marijuana use.[7] That study found no effect on self-reported prevalence or frequency of use. In contrast, Melanie Wall and colleagues reported that states that passed a medical marijuana law had significantly higher rates of marijuana use and abuse among adolescents, compared to states with no such law, though the estimated effects were largely associations.[8] In a later study that attempted to replicate the results of Wall and colleagues, Sam Harper and coauthors found that when researchers used statistical methods that identified causal effects, the effect of medical marijuana laws on drug use largely disappeared.[9]

These findings are representative of an unsettled literature. Earlier studies did not generally use statistical methods such as those of Harper and coauthors, but later studies did—and the later studies tended to find only insignificant effects or a mix of significant and insignificant ones.

One issue that has received surprisingly little attention is the question of whether medical marijuana is being used clinically to any significant degree. To the extent that physicians recommend the use of marijuana to their patients to manage conditions that it can treat, according to clinical evidence, one would expect marijuana to be primarily a substitute for existing prescription medications (for patients who did not respond to previous therapy or who respond better to marijuana than to previous treatment). Nonetheless, there are no published studies that investigate whether states' approval of medical marijuana changes the prescribing patterns for pharmaceuticals approved by the FDA.

In this study we asked two straightforward questions. First, does implementing a medical marijuana law change prescribing patterns in Medicare Part D for traditional (FDA-approved) drugs that treat conditions marijuana itself might treat? Second, if it does, what is the effect on overall spending—both by Medicare and by enrollees out of pocket—of such changes?

Conceptual Framework

Two competing forces can drive prescription behavior when a medical marijuana law is implemented. The primary effect one expects is that prescribing for FDA-approved drugs will fall when a medical marijuana law is put in place, because marijuana is often a substitute for existing therapies. For most FDA-approved prescription drugs for which medical marijuana can serve as a replacement, we hypothesized that prescribing would decline.

However, this substitution effect model does not account for the secondary effect from demand expansion that might result from the introduction of a new product. When new products are made available, information sets change because of influences such as discussion of the treatment option in the media. Media coverage may draw new patients into physicians' offices, much as direct-to-consumer advertising does.[10–12] If not all new patients are diverted to marijuana, then prescription drug use might rise, even if those drugs and marijuana are clinical substitutes for each other.

Glaucoma is a notable condition for which demand expansion might swamp substitution. Clinical evidence is very strong that while marijuana sharply reduces intraocular pressure, the effect lasts only about an hour.[13] As a result, new patients who seek glaucoma treatment after learning about the potential benefits of marijuana are likely to receive a prescription for an FDA-approved drug. The prognosis for untreated glaucoma is very ominous. Thus, we expected that prescribing for glaucoma drugs would remain unchanged or even rise with the implementation of a medical marijuana law.

Study Data And Methods

DATA Our data came from the Medicare Part D Prescription Drug Event Standard Analytic File for the period 2010–13. These data contain information on all prescription drugs paid for under Medicare Part D. Each record in the data represents a specific drug prescribed by a physician in a given year and contains information on the total number of daily doses filled and the total expenditures (the amount paid by Medicare, patients' out-of-pocket expenditures, and any low-income subsidies for deductibles and copayments under the Affordable Care Act). We linked these data to basic information on the prescribing physicians, including sex, specialty, and location of home and business addresses.[14] The baseline data contained more than eighty-seven million physician-drug-year observations.

We restricted the analysis to drugs that treat conditions for which marijuana might be an al-

ternative treatment. We obtained guidance on which conditions were in that category from the states' medical marijuana legislation, which explicitly mentions certain conditions;[15] from summaries of the clinical evidence in a 1999 Institute of Medicine review;[13] and from a recent comprehensive meta-analysis.[16] We selected nine broad clinical condition categories to study, based on the intersection of this reviewed clinical evidence and the list of conditions mentioned in state medical marijuana laws. A list of these condition categories and information about the clinical evidence for the use of marijuana in treating them appear in Exhibit 1.

Once the relevant condition categories were selected, we had to determine which drugs to study. In clinical practice, patients may be prescribed drugs that have been formally approved by the FDA to treat their diagnosed conditions (an on-label prescription) or drugs that do not have such formal approval (an off-label prescription).[17] If we chose only drugs that were on label, we might have overlooked a large number of drugs that were used to treat the condition categories listed in Exhibit 1.

For our analysis, we extracted data on all drugs that were in a drug class that had at least one on-label option to treat one or more of the condition

EXHIBIT 1

Nine medical condition categories with at least one drug approved by the Food and Drug Administration for on-label use, and level of evidence for marijuana as a treatment for conditions in the category

	Condition category								
	Anxiety	Depression	Glaucoma	Nausea	Pain	Psychosis	Seizures	Sleep disorders	Spasticity
CLINICAL EVIDENCE OF MEDICAL MARIJUANA EFFECT ON CONDITIONS IN EACH CATEGORY									
Institute of Medicine (1999)[a]	Present	—[b]	Insufficient	Present	Present	—[b]	Insufficient	—[b]	Insufficient
Whiting et al. (2015)[c]	Very low	Very low	—[b]	Low	Moderate	Low	—[b]	Low or very low	Low to moderate
DRUG CLASSES WITH AT LEAST ONE ON-LABEL OPTION FOR TREATING CONDITIONS IN EACH CATEGORY									
Adrenal cortical steroids					•				
Analgesics					•				
Antiarrhythmic agents							•		
Anticonvulsants	•	•			•	•	•	•	
Antidepressants	•	•			•	•			
Antidiarrheal agents				•					
Antiemetic or antivertigo agents				•	•				
Antimalarial agents					•				
Antipsychotics		•				•			
Antirheumatics					•				
Anxiolytics, sedatives, and hypnotics	•					•		•	
Central nervous system stimulants								•	
Functional bowel disorder agents					•				
Immunostimulants									•
Muscle relaxants					•				•
Ophthalmic preparations			•						
Proton pump inhibitors				•					
Respiratory inhalant products					•				
Sedatives and hypnotics	•					•		•	
Smoking cessation agents	•	•							

SOURCE Authors' analysis of principal findings in Institute of Medicine. Marijuana and medicine (Note 13 in text); and Whiting PF, et al. Cannabinoids for medical use (Note 16 in text). **NOTES** The nine condition categories were selected based on their inclusion in at least four states' medical marijuana laws and the two comprehensive clinical studies cited in the exhibit. [a]Classifying evidence of effect as either present (without rating the strength of the evidence) or insufficient. [b]No review of the effects of marijuna were provided for conditions in these categories. [c]Classifying evidence of effect on a scale from moderate to very low.

Our research suggests that more widespread state approval of medical marijuana could provide modest budgetary relief.

categories listed in Exhibit 1. This resulted in a set of both on- and off-label drugs used to treat each of our study condition categories, while excluding off-label drugs that were pharmacologically far removed from the on-label options.

We saved these prescription data in separate analytic data sets, one for each condition category listed in Exhibit 1. We aggregated the data to the physician-year level, so that each line in the data represented the number of daily doses (and associated Medicare program and enrollee out-of-pocket costs) that were filled for all prescriptions written by each physician in the particular condition category each year. The final physician-level analytic data sets, which were aggregations of all Medicare Part D prescriptions for our selected drugs, ranged in size from 588,808 observations for the spasticity diagnosis sample to 2,496,608 observations for the pain diagnosis sample.

More details on the data and data construction methods can be found in the online Appendix.[18]

BASIC MODELS The key variable of interest was an indicator of when prescriptions were filled in a state and year with an effective medical marijuana law in place—that is, where it was legal for state residents either to use home-grown marijuana or to purchase marijuana in a dispensary and where such a dispensary was open. Covariates included physician and state characteristics. We also included county-level demographic variables from the Area Health Resources Files that were expected to influence the aggregate demand for drugs dispensed under Medicare Part D.[19]

We used a simple difference-in-differences regression framework estimated separately for each of the nine condition categories listed in Exhibit 1. All models were estimated with least squares regressions. Each of the estimated models were corrected for clustering at the physician level. Details of the model variables are included in the Appendix.[18]

In addition to estimating changes in prescribing patterns with the implementation of a medical marijuana law, we estimated changes in Medicare Part D payments (including government low-income subsidies for copayments and deductibles) and patients' out-of-pocket spending. Details of how we conducted this analysis can be found in the Appendix.[18]

LIMITATIONS Our study had several limitations. First, previous studies have suggested that Medicare patients may make up a relatively small percentage of people who use medical marijuana and that only 13–27 percent of people who used medical marijuana were ages fifty and older.[20,21] Thus, while our study illuminated the behaviors of a generally older population in response to implementation of medical marijuana laws, future research is needed to understand the prescription drug use responses of younger people.

Second, our study of prescribing behavior at the physician level could not explore important remaining questions about the mechanism of the response. It is certainly plausible that forgoing medications with known safety, efficacy, and dosing profiles in favor of using marijuana (despite its reasonably favorable safety profile) could be harmful under some circumstances. In addition, patients who switch from a prescription drug that requires regular physician monitoring to marijuana, which requires no monitoring, may interact with the health care community less often overall than they did before switching to marijuana, and adherence to other important treatment regimens could be compromised. Again, we leave exploration of these important issues to future research.

Study Results

Our simple bivariate comparisons demonstrated that, with the exception of glaucoma, fewer prescriptions were written for any of our study condition categories when a medical marijuana law was in effect (Exhibit 2). When we controlled for other factors that might have been driving differences in prescribing across states that did and did not have medical marijuana law in effect, we found similar results.

The results for our difference-in-differences models of daily doses filled were extremely consistent across condition categories (Exhibit 3). For seven of the categories—all but glaucoma and spasticity—we found that implementing an effective medical marijuana law led to a reduction of between 265 daily doses (for depression) and 1,826 daily doses (for pain) filled per physician per year. The effects of a medical marijuana law on those seven categories were all significant ($p < 0.01$), with magnitudes that were econom-

EXHIBIT 2

Daily doses filled per physician per year in states with and without a medical marijuana law

Condition category	Annual number of daily doses prescribed per physician in states: Without a medical marijuana law	With a medical marijuana law	Difference
Anxiety	11,220.29	10,113.77	1,106.51***
Depression	9,576.73	8,296.25	1,280.47***
Glaucoma	2,551.40	2,616.04	–64.64***
Nausea	10,067.92	9,040.22	1,027.70***
Pain	31,810.07	28,165.54	3,644.53***
Psychosis	11,421.46	10,298.60	1,122.86***
Seizures	9,398.60	8,028.74	1,369.85***
Sleep disorders	7,557.97	6,942.94	615.03***
Spasticity	2,067.82	1,645.43	422.38***

SOURCE Authors' analysis of data for 2010–13 from the disease-specific extracts in the Medicare Part D Prescription Drug Event Standard Analytic File. ***$p < 0.01$

ically important. We found no statistically or economically significant effect on glaucoma or spasticity.

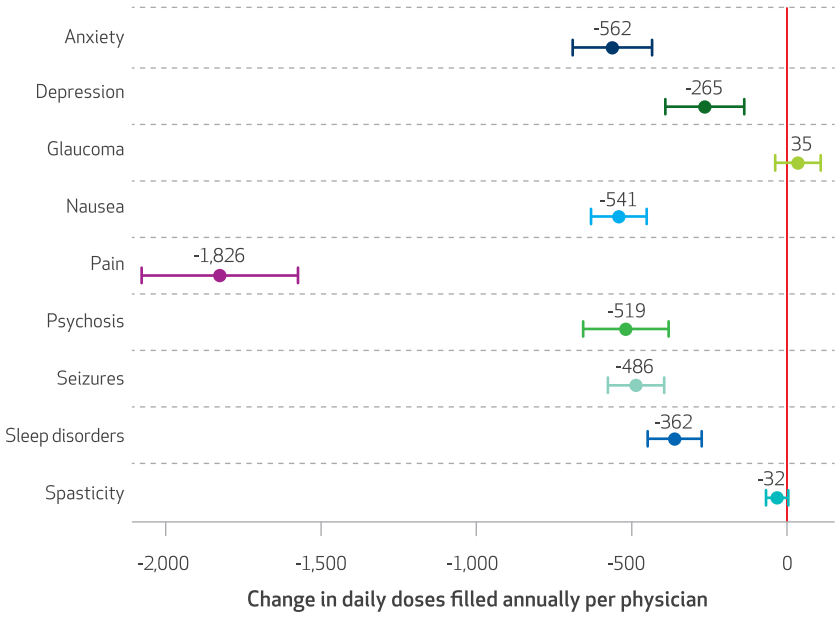
To confirm that these effects were causally related to implementing a medical marijuana law, and not due to some unobserved characteristic of the states that affected general prescribing and adoption of a medical marijuana law, we selected drugs from four classes—blood-thinning agents, phosphorous-stimulating agents, antivirals used to treat influenza, and antibiotics—in which there is no evidence of any beneficial (or harmful) effect from the use of medical marijuana.

We found no changes after implementation of a medical marijuana law in the number of daily doses filled in condition categories with no medical marijuana indication. This provides strong evidence that the observed shifts in prescribing patterns were in fact due to the passage of the medical marijuana laws. Results from these models are presented in the Appendix.[18]

Our analysis suggested that prescription drug spending in Medicare Part D—that is, both program and enrollee spending—fell by $104.5 million in 2010 and that cost savings had risen to $165.2 million by 2013 (Exhibit 4). The savings accrued from only seventeen states and the District of Columbia—jurisdictions that had implemented a medical marijuana law by 2013. Assuming the remaining states are of similar size, we forecast that if all states were to have adopted a medical marijuana laws by 2013, total spending by Medicare Part D would have been $468.1 million less in that year than it would have been had no state adopted such a law. That amount would have represented just under 0.5 percent of all Medicare Part D spending in 2013.

EXHIBIT 3

Average numbers of daily doses filled for prescription drugs annually per physician in states with a medical marijuana law, by condition categories studied, compared to the average numbers in states without a law



SOURCE Authors' analysis. **NOTES** To interpret this exhibit, negative numbers indicate that fewer daily doses of the indicated prescription drugs were filled in states with medical marijuana laws than in states without them. Dots represent the estimated effect (regression coefficient) of the implementation of a law, and lines represent the upper and lower bounds of 95% confidence intervals. Data were aggregated to all prescriptions in a disease category by physician.

Discussion

As of June 2016 twenty-four states and the District of Columbia had passed a medical marijuana law (though not all states had fully implemented their laws by that time), and there is a growing academic literature on the effects of these laws. Researchers have investigated negative externalities associated with medical marijuana, such as spillovers from medical marijuana to recreational use of the drug among adults and youth, and changes in the number of traffic fatalities following the implementation of a medical marijuana law, among other topics.

Remarkably, there is no literature that investigates the extent to which marijuana is used medically as a result of implementing medical marijuana laws at the state level. In this article we provide the first, albeit somewhat indirect, evidence on the clinical impact of medical marijuana availability by examining the impact of medical marijuana laws on the use of all FDA-approved prescription drugs paid for by the Medicare Part D program.

Generally, we found that when a medical marijuana law went into effect, prescribing for FDA-

approved prescription drugs under Medicare Part D fell substantially. The only exceptions were for spasticity- and glaucoma-related drugs. Ultimately, we estimated that nationally the Medicare program and its enrollees spent around $165.2 million less in 2013 as a result of changed prescribing behaviors induced by seventeen states and the District of Columbia—the jurisdictions that had legalized medical marijuana by then.

Policies surrounding the appropriate use of medical marijuana are the subject of intense and ongoing debate, and the research we have presented here has direct implications for multiple aspects of the evolution of those policies. State reforms to medical marijuana policies are constrained by the current status of marijuana as a Schedule I drug under the Controlled Substances Act. That status prohibits any sale of marijuana under federal law because the drug is defined to have a high potential for abuse and no medical benefit; thus, many state laws now contradict federal law. Our findings and existing clinical literature imply that patients respond to medical marijuana legislation as if there are clinical benefits to the drug, which adds to the growing body of evidence suggesting that the Schedule I status of marijuana is outdated.

Additionally, at a time when Medicare is under increased fiscal pressure, our research suggests that more widespread state approval of medical marijuana could provide modest budgetary relief. Although some of the savings are likely to be a transfer of costs from the Medicare program to beneficiaries who would have purchased marijuana out of pocket, saving $468.1 million annually is not trivial. As noted above, that would represent about 0.5 percent of total Part D spending for 2013.

Finally, while we did not directly test the impact on governmental programs other than Medicare—most importantly, Medicaid—finding significant cost savings for Medicare suggests that other programs might also enjoy budgetary reductions when medical marijuana laws are implemented. Lowering the costs of Medicare and other programs is not a sufficient justification for approving marijuana for medical use, a decision that is complex and multidimensional. Nonetheless, these savings should be considered when changes in marijuana policy are discussed. ■

EXHIBIT 4

Estimated annual change in national Medicare spending after implementation of state medical marijuana laws, by year

Year	Estimated change ($)
2010	−104,513,189
2011	−114,995,271
2012	−130,491,985
2013	−165,193,681
2010–13	−515,194,125

SOURCE Authors' analysis of data for each year from the disease-specific extracts in the Medicare Part D Prescription Drug Event Standard Analytic File. **NOTES** "Medicare spending" consists of spending by the program and beneficiaries' out-of-pocket spending. More information on the cost calculations is available in the online Appendix (see Note 18 in text).

The authors thank seminar participants at the University of North Carolina at Chapel Hill and Texas A&M University for comments on an earlier presentation of this research.

NOTES

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14 For the years 2010–12, when the data originated from a request by ProPublica under the Freedom of Information Act of 1966, only physician National Provider Identifier (NPI) numbers appeared in the public use Medicare Part D Prescription Drug Event Standard Analytic File data. We merged information on physician characteristics and practice location and the analysis file according to the NPI number and the National Plan and Provider Enumeration System of the Centers for Medicare and Medicaid Services.

15 For more details on state laws with links to legislative language, see Note 3.

16 Whiting PF, Wolff RF, Deshpande S, Di Nisio M, Duffy S, Hernandez AV, et al. Cannabinoids for medical use: a systematic review and meta-analysis. JAMA. 2015;313(24):2456–73.

17 For example, beta-blockers such as metaprolol and propranolol have been used for decades to treat hypertension, cardiac dysrhythmias, and other related diagnoses. Researchers have noted that beta-blockers also control physical sensations associated with anxiety (such as rapid heartbeat, tightness in the chest, and trembling) and that when patients do not feel these sensations, their psychological experience of anxiety is significantly reduced. As a result, these drugs are widely prescribed for situational and other forms of anxiety, even though they are not officially approved for that indication by the FDA. An estimated 52 percent of prescriptions for beta-blockers in the period 1999–2002 were for off-label use. See Lin HW, Phan K, Lin SJ. Trends in off-label beta-blocker use: a secondary data analysis. Clin Ther. 2006;28(10):1736–46; discussion 1710–1.

18 To access the Appendix, click on the Appendix link in the box to the right of the article online.

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