Published in final edited form as:

J Subst Abuse Treat. 2018 November ; 94: 35–40. doi:10.1016/j.jsat.2018.08.006.

Variations in Prescription Drug Monitoring Program Use by Prescriber Specialty

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Abstract

Background—Although prescription drug monitoring programs (PDMPs) have been widely implemented to potentially reduce abuse of prescription opioids, there is limited data on variations in PDMP use by prescriber specialty. Such knowledge may guide targeted interventions to improve PDMP use.

Methods—Using data from Washington state Medicaid program, we performed a retrospective cohort study of opioid prescribers and their PDMP queries between Nov 1, 2013 to Oct 31, 2014. PDMP registration was mandatory for emergency physicians, but not for other providers. The unit of analysis was the prescriber. The primary outcome was any prescriber queries of the PDMP. We used multivariate regression models to identify variations in PDMP queries by prescriber specialty, as well as to explore explanatory pathways for observed variations.

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Contributors

BCS developed the study question. BCS and KJM obtained funding. NLM and CJC had direct access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. NLM and CJC performed all data management and analysis. BCS prepared the manuscript, and all authors made substantial edits and revisions. BCS has overall responsibility for this study.

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Conflict of Interest

The study team had full responsibility for the design of the study, in the collection, analysis, and interpretation of the data; in the preparation, review and approval of the study report. All the authors declare that they have no conflict interest.

Results—We studied 17,390 providers who prescribed opioids, including 8,718 (50%) who were not registered with PDMP, 4,767 (27%) who were registered but had no recorded use of the PDMP, and 3,905 (23%) PDMP users (queries/ user: median 18, IQR 5-64). Compared to general medicine physicians, PDMP use was higher for emergency physicians (OR 1.4, 95%CI: 1.2-1.7), and lower for surgical specialists (OR 0.1, 95%CI:0.08-0.1), obstetrician-gynecologists (OR 0.2, 95%CI: 0.1-0.2) and dentists (OR 0.4, 95%CI: 0.4-0.5). Higher use by emergency physicians appeared to be mediated by higher registration rates, rather than by provider level predilection to use the PDMP.

Conclusions—A minority of opioid prescribers to Medicaid beneficiaries used the PDMP. We identified variations in PDMP use by prescriber specialty. Interventions to increase PDMP queries should target both PDMP registration and PDMP use after registration, as well as specialties with current low use rates.

Keywords

prescription drug monitoring program

1. Introduction

1.1. Background

Drug overdoses are now the top reason for unintentional mortality in the United States, and prescription opioid abuse is a major contributor to this public health crisis.(Seth, Scholl, Rudd, & Bacon, 2018; "CDC. Prescription opioid overdose data.," 2016) Nearly all states have adopted prescription drug monitoring programs (PDMPs) that track dispensed controlled substances to unique patients.(Gugelmann & Perrone, 2011) PDMP data may help providers improve opioid prescribing behaviors, particularly to patients with a prior history of high-risk prescription opioid use. State-level data suggest that introduction of PDMPs may be reduce opioid supply and opioid “shopping” behavior.(Buchmueller & Carey, 2017; Pardo, 2016)

1.2. Importance

Preliminary studies suggest that, in the past, prescribers and pharmacists rarely use PDMPs(Feldman, Williams, Coates, & Knox, 2011; McCauley, Leite, Melvin, Fillingim, & Brady, 2016; Perrone, DeRoos, & Nelson, 2012; H. W. Young, 2nd, Tyndall, & Cottler, 2017) due to logistic and time constraints.(Greenwood-Ericksen, Poon, Nelson, Weiner, & Schuur, 2016; Poon et al., 2016) States have responded with a variety of policies, including requirements for mandatory PDMP use prior to opioid prescribing(Buchmueller & Carey, 2017) and integrated systems that “push” PDMP data to emergency department physicians. ("Washington ACEP. EDIE and PMP Integration," 2015)

However, there are limited data on variation of PDMP use by prescriber specialty. Prior studies of prescriber PDMP use are limited by survey methodology, low response rates, and potential recall and selection bias.(Feldman et al., 2011; McCauley et al., 2016; Perrone et al., 2012; H. W. Young, 2nd et al., 2017) Furthermore, these surveys have typically targeted prescribers within specific specialties, limiting generalizability across all prescribers.

Improving knowledge of prescriber use patterns is essential for developing targeted interventions to improve PDMP use (e.g. directed at low-utilizing specialties). Identifying potential mechanisms to improve PDMP use is particularly important for prescribers to Medicaid beneficiaries, who have an six-fold increased risk of opioid overdose compared to other insured populations. ("CDC. Overdose deaths involving prescription opioids among medicaid enrollees - Washington, 2004-2007," 2009)

1.3. Goals of This Investigation

Using linked PDMP provider, query, and dispense files, we assessed prescriber specialty variation in PDMP use among opioid prescribers to Washington state Medicaid beneficiaries.

We further explored whether variations in PDMP query rates were mediated by registration rates or by predilection to use the PDMP among registrants. We exploited a natural policy experiment which required emergency physicians, but not other specialists, to register for the PDMP.

2. Methods

2.1. Study Design and Cohort Selection

We performed a retrospective cohort study of providers who prescribed opioids to Medicaid beneficiaries during the one-year period between November 1, 2013 and October 31, 2014. The Washington state PDMP started data collection on Schedule II III, IV, and V drugs starting October 2011. Prescriber and prescriber delegates could register for PDMP access using an online process. Starting in July 2012, all emergency physicians in Washington state were required to be registered with the PDMP.(Sun, Lupulescu-Mann, et al., 2017) Hospitals attested to compliance with this requirement. There have been no other registration or use requirements for other prescribers. In November 2014, Washington state began implementation of an automated PDMP query intervention in all non-federal emergency departments (EDs). This initiative increased the proportion of ED visits with a validated PDMP query from 4 to 70%.(Sun, Charlesworth, et al., 2017) To isolate the predictors of voluntary PDMP use from the effects of this policy intervention, we restricted the current study to the period prior to the automated ED PDMP queries.

We included health care providers if they wrote at least five opioid prescriptions for Medicaid beneficiaries during the study period and had a Drug Enforcement Agency number registered in Washington state.

The Washington state PDMP identified opioid prescribers to Medicaid beneficiaries, and provided dispense, prescriber, and query files to the study team. The dispense file included all instances of controlled substance dispensing to Medicaid beneficiaries. The prescriber file included specialty and PDMP registration status for unique prescribers in the dispense files. The query file included all PDMP queries on patients with a prior controlled substance dispense. Queries on patients without any prior controlled substance dispense are not recorded by the PDMP.

The Institutional Review Boards of Washington State and of Oregon Health & Science University approved this study.

2.2. Outcomes

The primary outcome was any recorded PDMP query made by a prescriber during the study period.

2.3. Provider Specialty

The PDMP vendor linked self-reported National Prescriber Identifier specialty data to the prescriber file. ("Center for Medicare and Medicaid Services. National Provider Identifier Registry," 2017) We aggregated specialty categories that were provided in the prescriber file (Appendix Table).

2.4. Co-variables

Increased volume of opioid prescribing may be correlated with PDMP use. If true, then measures of opioid prescribing frequency would potentially confound the relationship between specialty and PDMP use. To control for confounding, we used PDMP dispense data to create variables that describe past opioid prescribing. These variables included the total number of patients that each provider prescribed opioids for during the one year study period, as well as the total dispensed morphine milligram equivalents (MMEs) prescribed by each provider. We calculated MMEs using the following conversion factors ("Centers for Medicare and Medicaid Services. Opioid Morphine Equivalent Conversion Factors," 2015; "Oregon Health & Science University. Guideline for Safe Chronic Opioid Therapy Prescribing For Patients with Chronic Noncancer Pain," 2014; Paulozzi, Kilbourne, & Desai, 2011): codeine-0.15; fentanyl citrate-0.13; fentanyl patch-7.2; hydrocodone-1; hydromorphone-4; levorphanol-11; meperidine-0.1; methadone-3; morphine- 1; oxycodone-1.5; oxymorphone-3; and tapentadol- 0.4. We only considered oral / transdermal formulations.

2.5. Analysis

We wished to explore two possible, non-exclusive mechanisms for variations in PDMP use by specialty. First, there may be variations in registration by specialty, i.e. non-registered prescribers never have the opportunity to query the PDMP. Second, there may be variation in PDMP use among registered prescribers by specialty.

We generated descriptive tables of the prescriber cohort, stratified by the following three categories (1) Not registered with the PDMP, (2) Registered with the PDMP, but with no recorded PDMP query, and (3) Registered with the PDMP, and has at least one recorded PDMP query for the study year.

We used a multivariate logistic regression model to assess the association between any recorded PDMP query and prescriber specialty. The model included the two potential confounders described above. The unit of analysis was an individual prescriber, and all prescribers were included in the regression analysis regardless of PDMP registration status.

Because of right skewed data, we parameterized continuous variables using indicators for quintile values.

Using the same variables, we performed two additional logistic regression analyses to understand the reason for differences in PDMP use by specialty. First, we assessed the association between provider level variables and PDMP registration. Second, we assessed the association between provider level variables and PDMP use among those prescribers who were registered for the PDMP.

All data management and statistical analyses were performed in R version 3.3.2("R: A language and environment for statistical computing," 2015) and STATA MP 14.0.

3. Results

Our study cohort included 17,390 providers (Figure 1) who prescribed controlled substances to 506,249 Medicaid beneficiaries, including 1,739,672 opioid prescriptions Table 1 describes 8,718 (50%) prescribers who were not registered with PDMP, 4,767 (27%) who were registered but had no recorded use of the PDMP during the study period, and 3,905 (23%) PDMP users.

There were a total of 339,731 PDMP queries. Among PDMP users, there was large variation in the annual number of PDMP queries with a right skewed distribution (Median 18, IQR 5-64 Mean 87.0, SD 413.1). Comparing PDMP users to registered non-users, and registered non-users to unregistered prescribers, there were higher numbers of patients receiving prescription opioids, and a higher number of MMEs per prescriber.

There was marked variation by prescriber specialty in PDMP registration and use. General medicine and emergency medicine physicians had the highest rates of registration and use, whereas surgical specialists, obstetrician-gynecologists, and dentists had lower rates of registration and use.

The adjusted association between prescriber specialty and recorded PDMP use are presented in Table 2. Compared to general medicine practitioners, PDMP use was higher for emergency physicians (OR 1.4, 95%CI: 1.2-1.7), and lower for surgical specialists (OR 0.1, 95%CI: 0.08-0.1), obstetrician-gynecologists (OR 0.2, 95%CI: 0.1-0.2) and dentists (OR 0.4, 95%CI: 0.4-0.5). Prescribers aggregated into the "other" category were slightly less likely to use the PDMP (OR 0.8, 95%CI: 0.7-0.9).

Association of prescriber specialty with PDMP registration is presented in Table 3. Compared to general medicine practitioners, PDMP registration was highest for emergency physicians (OR 4.2, 95%CI 3.3-5.4), which is consistent with state mandates. Registration of all other specialty types was significantly lower than general medicine practitioners.

Finally, association between prescriber specialty and any recorded PDMP use conditional on PDMP registration is presented in Table 4. Compared to general medicine practitioners, PDMP use was similar for emergency physicians (OR 0.9, 95%CI: 0.7-1.0), and lower for

surgical specialists (OR 0.3, 95%CI: 0.2-0.5), obstetrician-gynecologists (OR 0.2, 95%CI: 0.2-0.3) and dentists (OR 0.6, 95%CI: 0.5-0.7).

4. Discussion

A minority of opioid prescribers to Washington state Medicaid beneficiaries used the PDMP. Half of prescribers were not registered with the PDMP. Of prescribers who were registered to use the PDMP, over half had no evidence of using the PDMP during the study year. We also identified variations in PDMP use by prescriber specialty. PDMP registration mandates specific to emergency medicine providers appear to have been effective, and increased PDMP use by emergency medicine providers is attributable primarily by higher registration rates rather than greater predilection to use the PDMP among registrants. Interventions to increase PDMP queries should target PDMP registration and specialties with current low use rates.

Our study builds on prior literature by using objective PDMP registration, query, and dispense data across all prescribing specialties. Most prior studies that attempted to quantify PDMP use have been based on physician surveys and have targeted specific specialties (e.g. toxicologists, dentists, or emergency physicians). (Feldman et al., 2011; McCauley et al., 2016; Perrone et al., 2012; H. W. Young, 2nd et al., 2017) Survey response rates in these studies have ranged from 4-61%, and reported PDMP use was not verified against objective data.

We found that general medicine and emergency medicine physicians had the highest rates of registration and use, whereas surgical specialists, obstetrician-gynecologists, and dentists had lower rates of registration and use. Our findings are concordant with a prior study by Irvine et.al. that combined Oregon PDMP registry data with a prescriber survey. (Irvine et al., 2014) They found that emergency medicine, pain and addiction, and primary care specialties were heavily represented in the any-user group, whereas surgeons, dentists, and psychiatrists were more heavily represented in the non-user group. Registered users of the PDMP reported prescribing all classes of controlled substances more often than non-registrants. However, many non-registrants also reported frequent prescribing of controlled substances.

During the study period, Washington state had PDMP registration mandates for emergency medicine specialists but not for any other specialties. Our results demonstrated that overall use of the PDMP by emergency medicine providers were driven by increased registration rates, rather than a greater tendency to use the PDMP despite multiple policies aimed at reducing emergency department opioid prescribing. (Sun, Lupulescu-Mann, et al., 2017) These results provide support of the effectiveness of Washington state's registration mandate, and suggest potential approaches to improving PDMP use consistent with the recommendations of a prior expert panel process. First, PDMP enrollment should be mandatory for all prescribers. (Greenwood-Ericksen et al., 2016) Over 20 states already have such requirements. To minimize burden on prescribers, PDMP enrollment could be automated and linked with renewal of state professional licensure. Second, policy makers should consider mandatory PDMP use prior to opioid prescription. Recent evaluations suggest that the requirement for mandatory PDMP use is associated with reduced opioid

prescribing to high-risk patients and less “shopping” behavior (multiple prescribers and/ or pharmacies for controlled substances)(Buchmueller & Carey, 2017; Pardo, 2016), and at least ten states already have such requirements.(Buchmueller & Carey, 2017) Third, logistical barriers to PDMP use should be minimized. A time-motion study of the Massachusetts PDMP found that a single query required nearly 4 minutes of provider time. (Poon et al., 2016) A potential solution is to automate PDMP queries and to integrate these data into existing EMRs. For example, Washington state has recently implemented an automated PDMP query system for all non-federal emergency departments.(Sun, Charlesworth, et al., 2017)

We did note that 12.7% of self-identified emergency physicians were not registered with the PDMP. Hospitals attested to the compliance of their eligible providers for the mandated PDMP registration requirement. However, to our knowledge, there was no state verification of compliance. Two possible reasons for the observed non-registration rate include: 1. Eligible providers did not register; 2. Self-reported classification was inaccurate (e.g. provider did not work in an ED environment at the time of the study. Our findings suggest that compliance with registration mandates be verified by objective PDMP data.

We found evidence of differential PDMP registration and use by specialty. These findings may be influenced by differences in practice culture and knowledge about the PDMP among specialties. These data could support professional society specific efforts to educate members about the opioid crisis and best prescribing practices. For example, there is increasing interest focused on opioid prescribing behaviors of dentists(Denisco et al., 2011) and surgeons.(“American College of Surgeons. Surgeon Stewardship of the Opioid Epidemic,” 2017)

Our recommendations are predicated on the assumption that PDMP use results in better patient outcomes through fewer overdose events. There is conflicting evidence on PDMP efficacy. Recent studies support the efficacy of PDMP in reducing opioid shopping behavior and overdose events(Bao et al., 2016; Buchmueller & Carey, 2017;Moyo et al., 2017; Patrick, Fry, Jones, & Buntin, 2016; Wen, Schackman, Aden, & Bao, 2017), although these findings are not universal.(Deyo et al., 2017; Nam, Shea, Shi, & Moran, 2017; Sun, Charlesworth, et al., 2017; Yarbrough, 2017) PDMP characteristics such as mandatory registration(Wen et al., 2017), mandatory use(Brown et al., 2017; Buchmueller & Carey, 2017; Pardo, 2016; Suffoletto, Lynch, Pacella, Yealy, & Callaway, 2017), clinical decision support, and monitoring of high risk activity(Pardo, 2016) are associated with greater efficacy. Several studies also suggest that providers alter prescribing behavior when given unsolicited PDMP data.(Baehren et al., 2010; Gonzalez & Kolbasovsky, 2012; L. D. Young, Kreiner, & Panas, 2017)

There are limitations of our study. First, the Washington state PDMP only captured queries on patients with prior controlled substance use. This is mitigated as an estimated 60% of opioid recipients in our study had evidence of controlled substance use prior to the study period. Second, our data were restricted to opioid prescribers of Washington Medicaid beneficiaries, and our findings need confirmation in other populations. However, we believe it is unlikely that ED providers change their PDMP query habits conditional on patients’

insurance coverage. Third, we did not include queries by delegates. However, we found that <0.4% of prescribers were associated with delegate queries only, suggesting minimal impact of whether prescribers are classified as PDMP users. Fourth, provider specialty was self-reported with a significant rate of missing data. This may potentially introduce bias into our results. Finally, to avoid confounding with a state-wide automated PDMP policy, we studied data prior to November 2014, and it is possible that PDMP use patterns have changed since then.

5. Conclusions

In summary, the PDMP was used by a minority of prescribers to Medicaid beneficiaries, despite a high prevalence of risky opioid use in patients who received opioid prescriptions. Interventions to increase PDMP queries should target both PDMP registration as well as specialties with current low use rates.

Acknowledgments

Role of Funding Source

This study was supported by National Institutes of Health (NIH) grant RO1DA036522.

The funding organization had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. The contents do not necessarily represent the official views of the National Institutes of Health.

Appendix Table 1.: Specialty Definitions

Category	Included specialties
General	Internal Medicine, Family Medicine, Hospitalist, General Practice
Surgical	Surgery, Orthopaedic Surgery, Urology, Otolaryngology, Neurological Surgery, Plastic Surgery, Thoracic Surgery (Cardiothoracic Vascular Surgery), Colon & Rectal Surgery, Transplant Surgery
Dentist	Dentist, Oral & Maxillofacial Surgery
Pediatrics	Pediatrics
Psychiatry & Neurology	Psychiatry & Neurology
Emergency Medicine	Emergency Medicine
Obstetrics & Gynecology	Obstetrics & Gynecology
Other	Specialist, Podiatrist, Anesthesiology, Pathology, Radiology, Dermatology, Preventive Medicine, Student in an Organized Health Care Education/Training Program, Physical Medicine & Rehabilitation, Ophthalmology, Nuclear Medicine, Allergy & Immunology, Optometrist, Independent Medical Examiner, Clinic/Center, Neuromusculoskeletal Medicine & OMM, Health Maintenance Organization, Pharmacist, Neuromusculoskeletal Medicine, Pain Medicine, Psychoanalyst, Registered Nurse, Phlebology, Nurse Practitioner, Psychologist, Occupational Therapist, Medical Genetics, Veterinarian, General Acute Care Hospital, Physical Therapist, Legal Medicine, Audiologist, Physician Assistant, Chiropractor, Acupuncturist

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Highlights

- The minority of opioid prescribers used the Prescription Drug Monitoring Program
- There are substantial variation in PDMP use by prescriber specialty
- Mandatory registration was associated with higher use by emergency physicians

Figure 1.
Study Cohort

Prescriber Characteristics

Table 1:

	PDMP Registration and Use		
	Not registered (N= 8,718)	Registered, Never Used PDMP (N= 4,767)	Registered, Used PDMP (N= 3,905)
Prescribing profile – mean(SD); median [IQR]			
Total patients that provider prescribed opioids for	34.5 (52.0); 19 [9-41]	58.2 (86.8); 30 [13-68]	73.2 (90.6); 44 [21-89]
Total MME prescribed by provider	57,470 (269,377); 7,716 [2,550-26,416]	123,738 (445,562); 16,715 [4,834-72,178]	324,989 (1,139,451); 38,945 [9,130-201,380]
Specialty – N (row%)			
General Medicine	1,783 (37.9)	1,457 (31.0)	1,461 (31.1)
Emergency Medicine	92 (12.7)	349 (48.0)	286 (39.3)
Surgical Specialty	1,059 (75.2)	294 (20.9)	56 (4.0)
Obstetrics & Gynecology	448 (74.4)	118 (19.3)	36 (6.3)
Other Specialty	909 (56.0)	383 (23.0)	331 (21.0)
Missing specialty	2,851 (49.0)	1,509 (25.9)	1,460 (25.1)
Dentist	1,576 (62.8)	657 (26.2)	275 (11.0)
Total number of PDMP queries			
– mean(SD);	0 (0);	0 (0);	87.0 (413.1);
median [IQR]	0 [0-0]	0 [0-0]	18 [5-64]

* p-value from chi-square test; all other p-values from ANOVA

Table 2.

Association between Provider Specialty and Any PDMP Use

Provider Characteristic	Odds Ratio	95% CI
<i>Total Number of Patients¹</i>	-	-
1st Quintile (<10)	<i>ref</i>	
2nd Quintile (10-18)	1.57	(1.36 - 1.82)
3rd Quintile (19-34)	2.31	(2.00 - 2.68)
4th Quintile (35-69)	2.68	(2.31 - 3.12)
5th Quintile (70)	3.81	(3.26 - 4.46)
<i>Total Prescribed MMEs¹</i>		
1st Quintile (0-2,742)	<i>ref</i>	
2nd Quintile (2743-8,049)	0.95	(0.81 - 1.11)
3rd Quintile (8,050-21,729)	0.96	(0.82 - 1.13)
4th Quintile (21,730-84,052)	1.43	(1.22 - 1.68)
5th Quintile (84,053)	2.11	(1.78 - 2.50)
Prescriber Specialty		
General Medicine	<i>ref</i>	
Emergency Medicine	1.43	(1.19 - 1.72)
Surgical Specialty	0.1	(0.08 - 0.13)
Obstetrics & Gynecology	0.16	(0.11 - 0.23)
Dentist	0.44	(0.37 - 0.52)
Other	0.81	(0.70 - 0.93)
Missing	0.89	(0.81 - 0.98)

¹ Categorized by quintiles

Table 3.

Association between Provider Specialty and PDMP Registration

Provider Characteristic	Odds Ratio	95% CI
<i>Total Number of Patients¹</i>	-	-
1st Quintile (<10)	<i>ref</i>	
2nd Quintile (10-18)	1.45	(1.31 – 1.61)
3rd Quintile (19-34)	1.76	(1.58 – 1.96)
4th Quintile (35-69)	2.02	(1.80 – 2.27)
5th Quintile (70)	3.27	(2.88 – 3.71)
<i>Total Prescribed MMEs¹</i>		
1st Quintile (0-2,742)	<i>ref</i>	
2nd Quintile (2743-8,049)	0.95	(0.85 – 1.06)
3rd Quintile (8,050- 21,729)	1.09	(0.97 – 1.23)
4th Quintile (21,730-84,052)	1.51	(1.33 – 1.71)
5th Quintile (84,053)	2.42	(2.10 – 2.79)
Prescriber Specialty		
General Medicine	<i>ref</i>	
Emergency Medicine	4.19	(3.31 – 5.35)
Surgical Specialty	0.23	(0.19 – 0.28)
Obstetrics & Gynecology	0.22	(0.19 – 0.25)
Dentist	0.57	(0.50 – 0.64)
Other	0.65	(0.58 – 0.74)
Missing	0.75	(0.69 – 0.82)

¹ Categorized by quintiles

Table 4.

Association between Prescriber Characteristics and PDMP Use, Conditional on PDMP Registration

Provider Characteristic	Odds Ratio	95% CI
<i>Total Number of Patients</i> ¹	-	-
1st Quintile (<10)	<i>ref</i>	
2nd Quintile (10-18)	1.27	(1.07 – 1.50)
3rd Quintile (19-34)	1.76	(1.49 – 2.09)
4th Quintile (35-69)	1.88	(1.58 – 2.24)
5th Quintile (70)	2.15	(1.80 – 2.57)
<i>Total Prescribed MMEs</i> ¹		
1st Quintile (0-2,742)	<i>ref</i>	
2nd Quintile (2743-8,049)	0.99	(0.82 – 1.18)
3rd Quintile (8,050- 21,729)	0.90	(0.75 – 1.08)
4th Quintile (21,730-84,052)	1.17	(0.98 – 1.41)
5th Quintile (84,053)	1.48	(1.21 – 1.81)
Prescriber Specialty		
General Medicine	<i>ref</i>	
Emergency Medicine	0.86	(0.70 – 1.04)
Surgical Specialty	0.32	(0.22 – 0.47)
Obstetrics & Gynecology	0.21	(0.15 – 0.28)
Dentist	0.57	(0.48 – 0.69)
Other	1.03	(0.87 – 1.22)
Missing	1.06	(0.95 – 1.18)

¹ Categorized by quintiles