

Updated legislative and operational dates produced by the protocol in this documents are available in Table 1 of Jill Horwitz, Corey Davis, Lynn McClelland, Rebecca Fordon, and Ellen Meara, “The importance of data source in prescription drug monitoring program research,” Health Services Research: online 02 September 2020. <https://doi.org/10.1111/1475-6773.13548>.

Updated and supplemental material available in this document includes:

1) updated research protocol and data descriptions for producing original database of PDMP legislation and operation dates;

2) Table 2. Enactment and Operational Dates Publicly Available Sources

4) Table 3. Must Query Dates Publicly Available Sources

4) Additional regression results:

Table 3. Any Opioid Prescription Received in Calendar Year

Table 4. Annual Daily Morphine Equivalents Based on Opioid Prescriptions

Table 5. High Dose Opioids (>120 mg daily morphine equivalents in any quarter)

Table 6. Opioid Prescriptions Filled at More than Four Pharmacies in Year

Figure 1. Any Opioid Prescription Received in Calendar Year Among all Medicare, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query

Figure 2. Annual Daily Morphine Equivalents Based on Opioid Prescriptions Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query

Figure 3. High Dose Opioids (>120 mg daily morphine equivalents in any quarter) Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query

Figure 4. Opioid Prescriptions Filled at More than Four Pharmacies in Year Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query

## **Research Protocol and Data Descriptions.**

Between January 2017 and July 2019, we identified three sets of PDMP start dates for each state: 1) Enactment of PDMP legislation, 2) Operation of an electronic PDMP program, and 3) Requirement for prescriber to query a PDMP before prescribing a controlled substance (“must query”). In February 2020, we updated the “must query” dates, Table 1, Column 5, as described at the end of this document.

These dates are in Table 1. Corresponding dates from publicly available sources are reproduced in Appendix 2 with notes specifying the dates at which the research team accessed each database.

### **I. Enactment Dates: Table 1, Columns 1 through 3.**

We first set out to identify a single date representing each state’s enactment of PDMP legislation. Because we could not apply a consistent definition of “enactment” across states, we generated three separate categories of enactment date as described here.

A. Table 1, Column 1, Enactment Date. This column contains the month and year that the legislation states dispensers or prescribers would be first required to either a) send, via mail or fax, physical copies of written or filled prescriptions to a central database or b) send, via electronic methods, data regarding written or dispensed prescriptions to a central database.

A small number of states required copies of paper prescriptions to be sent to a central repository. For these states, we note the month and year that these statutes required copies of paper prescriptions to be sent in Table 2, Column 1. (NB: some states had required prescribers or dispensers to keep records of prescriptions but not send them to a central repository – we do not code those states as having a PDMP).

For all other states, this column contains the month and year that a statute or regulation that authorized an electronic database to which information on dispensed prescriptions is required to be reported went into effect, subject to the following caveats:

1. If the statute is clear that the PDMP would not be required to exist until a date after the effective date of the statute, we note the date by which the PDMP is required to exist, not the effective date of the statute.
2. If the statute authorizes the PDMP contingent upon receipt of sufficient funding, we include the date that we find evidence that such funding was obtained by reaching outside the statute using the same protocol we used for determining the operational date as described below.

B. Table 1, Column 2, Enactment Funding Contingent. For the eleven states in which the statute makes PDMP operation contingent on funding, we include the date at which the statute authorizing the development of a PDMP contingent on funding was enacted. This date is typically, although not always, earlier than the date the funding is received. We report this date because researchers may believe that the existence of a statute, even one that is inoperative, may influence provider behavior and because it may be useful in analyzing that question or in sensitivity analyses.

C. Table 1, Column 3, Enactment: Electronic. For the twelve states, including some very large states, that had a paper-based system before they implemented an electronic system, we include an additional column listing the month and year that the state enacted (according to the definition above), a modern, electronic PDMP.

### **II. Modern System Operational Date: Table 1, Column 4.**

These dates represent the month and year that PDMP data became accessible to any user (e.g., physician, pharmacist, or member of law enforcement) authorized by state law to receive it. Many programs began requiring reporting before they began permitting or requiring prescribers, pharmacists,

or others to query the database. In these cases, we report the latter date, the date at which the database became operational from the perspective of the end user. In addition, some states operated pilot programs, allowing access to a small number of end users; we report the date at which the full program became operational and not the earlier date at which the pilot program began. We count a program as operational if the end user can access a database directly, rather than through a phone call or fax. We determined this date from the following sources:

- a. State Statutes. Some statutes state a date by which the PDMP must be accessible to users. We used these dates as a starting point for our research, and confirmed these dates with or updated them from the additional sources listed in (b)-(d) below.
- b. Regulations.
- c. Subregulatory materials such as policy documents or manuals from the agency that operates the PDMP.
- d. Other sources, including but not limited to:
  - i. State government reports on the PDMPs (e.g., those listing start dates and/or statistics on operations).
  - ii. Presentations by regulators.
  - iii. Medical or Pharmacy Board Announcements
  - iv. FAQs and historical materials sections of the state PDMP website
  - v. Phone calls to relevant governing agency
  - vi. In rare cases, we relied on press reports. If there were conflicting press reports, we made phone calls to the governing agency to determine the correct date.

### **III. Prescriber Must Query**

There are several different types of laws requiring providers and dispensers to check a PDMP before prescribing or dispensing a controlled substance. We focus on the measure most commonly used in the U.S. research on PDMP effectiveness, whether a prescriber must check a PDMP before prescribing a controlled substance. The controlled substances covered by such requirements vary by state. For example, some states required a PDMP check before any controlled substance is prescribed, others limit the requirement to certain scheduled drugs, and still others increased the reach of the law over time. We include the law as a “must query” law at the earliest date a law requires a prescriber to query a database for a substantial portion of opioids, e.g., “schedule 2 drugs.”

Some early laws only required a prescriber to query a PDMP if the prescriber had a reasonable suspicion the patient was misusing a controlled substance and/or if the patient was unknown to the prescriber. Because laws with exemptions this broad likely mean a query is not required for most patients, we have not included states with such a requirement as meeting our definition of “must query”. However, where laws have a broad “must check” requirement with narrow exemptions (for example, not requiring a prescriber to check for palliative care patients with cancer), we include them within the list of those requiring prescribers to query a PDMP.

The initial work, begun in January 2017 was performed by a law student research assistant under the close supervision of a law professor (Horwitz) and two JD research librarians at UCLA (McClelland and Fordon). Further analysis was performed by all of the authors.

Because the goal of this part of the project was to compare our dates to publicly available dates we used the following protocol, beginning with publicly-available sources:

#### **A. Initial Research: Statutes and Regulations.**

- a. Beginning in January 2017, for each state a law student searched for statutes and regulations beginning with the individual state web pages at the Prescription Drug Monitoring Program Training and Technical Assistance Center (PDMP TTAC) at Brandeis University website

(<http://pdmpassist.org/content/state-profiles>) as most state pages provide citations to the statutes and regulations. She checked these citations using Westlaw. The law student-researcher noted that PDMP TTAC sometimes listed a statute that was 1) different from the statute that included the must query requirement, or one that 2) did not meet our definition of a “must query” law, described above.

b. The first step often revealed whether a statute currently required providers to check a PDMP before prescribing but did not provide historical information necessary to perform an analysis on the relationship between the laws and various outcomes. Therefore, the law student also researched all relevant statutes via Westlaw to find the legislative history, starting with the oldest history date working towards the present.

c. For some states, not all of the relevant history necessary to establish a start date for the mandatory checking requiring was available via legal research databases. The research assistant checked the UCLA Law Library for paper versions of older statutes.

d. Some states require providers to check PDMPs via regulation rather than statutes. Therefore, the RA also checked all relevant state law regulations via Westlaw, state websites, and paper records at the UCLA Law Library and via interlibrary loan when the law school did not have them on site. When required, the RA checked Westlaw and state websites for historical versions of regulations or regulatory history.

## B. Review and Analysis of Initial Research

a. In Fall 2017, D filled in any missing information and resolved conflicting sources with further research, using the sources described above.

b. In January/February 2018, McClelland reviewed the draft database, and checked sources. She compared the database to publicly available dates at the Prescription Drug Monitoring Program Training and Technical Assistance Center to recheck the reason for any conflicts.

c. In spring and summer 2018, Horwitz and Meara reviewed the results, including much of the underlying material, and McClelland and Fordon further investigated the dates for six states. In summer 2019, Davis reexamined the dates to see if they corresponded with dates that he collected as part of another project and noted a small number of discrepancies. McClelland and Fordon once again checked the dates against other publicly available resources, including state regulatory registers on Lexis, and investigated, where possible, why any conflicts in dates remained. The final dates represent the consensus of the research team, using the criteria outlined in III.

d. In addition, in February 2020, Horwitz, Meara, and McClelland updated the “must query” column to include some legislation that became effective by July 2019, but that we had not included because the legislation was passed after we had fully analyzed the particular state. Therefore, we included the following dates in the must query column: Hawaii July 2018, Iowa July 2018, Michigan June 2018. Importantly, none of these dates affect our empirical illustration.

**Table 1. PDMP legislation and operation dates, Horwitz et al. (2020)**

	(1)	(2)	(3)	(4)	(5)
Jurisdiction	Enactment	Enactment: Funding Contingent	Enactment: Electronic	Modern System Operational	Prescriber Must Query
Alabama	Nov-05	Aug-04		Apr-06	Mar-17
Alaska	Sep-08			Jan-12	Jun-18
Arizona	Sep-07			Dec-08	Oct-17
Arkansas	Mar-13	Jul-11		May-13	Aug-17
California	Pre-1990		Jan-05	Sep-09	Oct-18
Colorado	Jun-05			Feb-08	
Connecticut	Oct-06			Jul-08	Oct-15
Delaware	Sep-11	Jul-10		Aug-12	
DC	Feb-14			Oct-16	
Florida	Dec-10			Oct-11	Jul-18
Georgia	Jul-11	Jul-11		May-13	Jul-18
Hawaii	Pre-1990		Dec-96	Feb-12	Jul-18
Idaho	Pre-1990		Apr-00	Apr-08	
Illinois	Pre-1990		Apr-00	Dec-09	Jan-18
Indiana	Pre-1990		Jul-07	Jul-07	
Iowa	May-06	May-06		Mar-09	Jul-18
Kansas	Jul-08			Apr-11	
Kentucky	Jul-98			Jul-99	Jul-12
Louisiana	Jul-06			Jan-09	Aug-14
Maine	Jan-04	Jan-04		Jan-05	Jan-17
Maryland	Oct-11	Oct-11		Dec-13	Jul-18
Massachusetts	Dec-92		Feb-13	Jan-11	Dec-14
Michigan	Pre-1990		Jan-02	Jan-03	Jun-18
Minnesota	Jan-09	Jul-07		Apr-10	
Mississippi	Jun-06			Jul-08	
Missouri	Jul-17				
Montana	Jul-11			Oct-12	
Nebraska	Aug-11			Jan-17	
Nevada	Jan-96			Feb-11	Oct-15
New Hampshire	Jun-12			Oct-14	May-16
New Jersey	Aug-09			Jan-12	Nov-15
New Mexico	Jul-04			Aug-05	Feb-13
New York	Pre-1990		Oct-06	Jun-13	Aug-13
North Carolina	Jan-06			Jul-07	Jun-17
North Dakota	Dec-06	Apr-05		Oct-08	Jan-18
Ohio	May-05			Oct-06	Apr-15
Oklahoma	Jan-91			Jul-06	Nov-15
Oregon	Jul-09			Sep-11	
Pennsylvania	Pre-1990		Jun-15	Aug-16	Jun-15
Rhode Island	Pre-1990		Aug-95	Sep-12	Jun-16

<b>South Carolina</b>	Jun-06			Feb-08	May-17
<b>South Dakota</b>	Mar-10			Mar-12	
<b>Tennessee</b>	Jan-03			Jan-10	Apr-13
<b>Texas</b>	Aug-81		Sep-99	Aug-12	Sep-19
<b>Utah</b>	Jul-95			Jan-06	May-18
<b>Vermont</b>	Jun-08	May-06		Jan-09	Nov-13
<b>Virginia</b>	Sep-03			Jun-06	Jul-15
<b>Washington</b>	Aug-11	Jul-07		Jan-12	
<b>West Virginia</b>	May-96		Sep-02	May-13	Jun-12
<b>Wisconsin</b>	Jun-10			Jun-13	Apr-17
<b>Wyoming</b>	Jul-03			Jul-13	

**Note:** “Enactment” is date when state required a dispenser or prescriber to report a written or filled prescription, including paper submissions. For statutes requiring state to secure funding before mandating reporting, date is when funding was secured. “Enactment, Funding Contingent” is date at which the statute requiring funding to be secured before mandating reporting was passed. “Enactment, Electronic” is date at which enacted law creating a modern, electronic PDMP. “Modern System Operational” is date at which PDMP data became accessible to any user (e.g., physician, pharmacist, or member of law enforcement) authorized by state law to receive it. “Prescriber Must Query” is date at which law mandated prescriber to check a database before prescribing a listed opioid. All dates determined according to the detailed research protocol described in Appendix 1. The dates in columns 1-4 were current up to July 2019, and in column 5 up to February 2020.

**Table 2a. Enactment and Operational Dates Publicly Available Sources**

	(1)	(2)	(3)	(4)	(5)	(6)
Jurisdiction	PDAPS Enabling Legislation	PDAPS Operational	PDAPS User Access	NAMSDL Enactment	NAMSDL Collection Began	NAMSDL User Access
Alabama	May-05	Dec-05	Jun-07	May-04	Apr-06	Aug-07
Alaska	Sep-08	Jul-11	Dec-11	Jun-08	Aug-11	Jan-12
Arizona	Sep-07	Sep-08	Nov-08	Jul-07	Oct-08	Dec-08
Arkansas	Mar-11	Feb-13	May-13	Mar-11	Mar-13	Mar-13
California	Dec-38	Dec-38		Sep-03	1998	2009
Colorado	Jun-05	Jun-07	Feb-08	Jun-05	Jul-07	Feb-08
Connecticut	Jun-06	Jun-08		Jun-06	Jul-08	
Delaware	Jul-10	Feb-12	Aug-12	Jul-10	Mar-12	Aug-12
District of Columbia	Feb-14			Feb-14		
Florida	Jun-09	Aug-11	Oct-11	Jun-09	Sep-11	Oct-11
Georgia	May-11	Jun-13	Jun-13	May-11	Jul-13	Jul-13
Hawaii	Dec-42	Dec-42		Jun-96		
Idaho	Dec-66	Dec-66	May-99	Apr-00	fall 1997	spring 1998
Illinois	Dec-60	Dec-67		Aug-99		
Indiana	Dec-96	Dec-97		Mar-06	1994	2007
Iowa	May-06	Dec-08	Mar-09	May-06	Jan-09	Mar-09
Kansas	Jun-08	Jan-11	Mar-11	Apr-08	Feb-11	Apr-11
Kentucky	Jul-98	Dec-98	Jun-99	Apr-98	Jan-99	Jul-99
Louisiana	Jun-06	Oct-08	Dec-08	Jun-06	Jun-08	Jan-09
Maine	Jun-03	Jun-04	Dec-04	Jun-03	Jul-04	Jan-05
Maryland	May-11	Aug-13	Dec-13	May-11	Aug-13	Jan-14
Massachusetts	Dec-91	Dec-93		Aug-10		
Michigan	Dec-87	Dec-88		Jan-02	Jan-03	Feb-03
Minnesota	Jun-07	Jan-10	Apr-10	May-07	Jan-10	Apr-10
Mississippi	Dec-04	Dec-04	Nov-05	Apr-06	2005	Dec-05
Missouri				No program		
Montana	Jun-11	Mar-12	Oct-12	Apr-11	Mar-12	Oct-12
Nebraska	Apr-11	Apr-11	Apr-11			
Nevada	Jun-95	Dec-96	Jun-97	Jul-95	Jan-97	Apr-97
New Hampshire	Jun-12	Sep-14	Oct-14	Jun-12	Oct-14	Oct-14
New Jersey	Jan-08	Aug-11	Jan-12	Jan-08	Sep-11	Jan-12
New Mexico	Jul-04	Dec-04	Jul-05	Jul-04	Jan-05	Aug-05
New York	Dec-71	Mar-73	Jan-10	Apr-73		
North Carolina	Aug-05	Jun-07	Sep-07	Aug-05	Jul-07	Oct-07
North Dakota	Nov-05	Aug-07	Aug-07	Apr-07	Jan-07	
Ohio	May-05	Jun-06	Oct-06	Dec-04	Jan-06	Oct-06
Oklahoma	May-90	Dec-90		May-90	1990	Jul-06
Oregon	Jul-09	May-11	Aug-11	Jul-09	Jun-11	Sep-11
Pennsylvania	Dec-71	Dec-72				
Rhode Island	Dec-77	Dec-78		Nov-01		
South Carolina	Jun-06	Jan-08	Aug-08	Jun-06	Feb-08	Jun-08
South Dakota	Mar-10	Dec-11	Feb-12	Mar-10	Dec-11	Mar-12

Tennessee	Dec-02	Nov-06	Dec-06	May-90		
Texas	Aug-81	Dec-81	Dec-81	Jun-89		
Utah	Dec-94	Dec-95	Dec-96	Jan-95	Jan-97	Jan-97
Vermont	May-06	Dec-08	Mar-09	May-06	Jan-09	Apr-09
Virginia	Apr-02	Aug-03	May-06	Apr-02	Jun-06	Jun-06
Washington	Jul-07	Oct-11	Jan-12	May-07	Oct-11	Jan-12
West Virginia	Jun-95	Jun-95		Mar-95		
Wisconsin	May-10	Mar-13	May-13	May-10	May-13	May-13
Wyoming	Mar-03	Jun-04	Sep-04	Mar-03	2004	2004

**Sources:** Data downloaded by authors between January and May 2018. Columns 2-4 are from the Prescription Drug Abuse Policy System, <http://pdaps.org/datasets/pdmp-implementation-dates> (last checked April 26, 2018). Column 2, Enabling Legislation, is from survey question 1.1 question – When was the PDMP enabling legislation first enacted? Column 3, Operational, is from survey question 1.2 When did the PDMP become operational? Column 4 User Access, is from survey question 1.3 When did the PDMP first allow authorized users to access the data?. Dates in columns 5-7 are from the National Alliance for Model State Drug Laws, PMDP Dates of Operation Report <https://web.archive.org/web/20180419233955/https://namsdl.org/library/580225E9-E469-AFA9-50E7579C1D738E71> (December 2014).

**Notes:** Empty cells and cells with no month listed reflect the data as reported in the original sources. For cells in which only a year was reported, we assigned the year a value of 0.5 in the regression analyses. Those cells for which only a season was reported did not matter for the regression analyses since the years were before the study periods.

**Table 2b. Must Query Dates Publicly Available Sources**

<b>Jurisdiction</b>	<b>NAMSDL</b>	<b>PDAPS</b>
Alabama		
Alaska	Jul-17	
Arizona	Oct-17	
Arkansas	Apr-17	
California	Sep-16	Jan-17
Colorado		
Connecticut	Oct-15	Oct-15
Delaware		
District of Columbia		
Florida		
Georgia	Jul-18	
Hawaii		
Idaho		
Illinois		
Indiana	Jul-16	July-14
Iowa		
Kansas		
Kentucky	Jul-12	Jul-12
Louisiana	Aug-14	Aug-14
Maine	Jul-18	Jan-17
Maryland	Jul-18	
Massachusetts	Jan-16	Jul-14
Michigan		
Minnesota		
Mississippi		
Missouri		
Montana		
Nebraska		
Nevada	Oct-15	Oct-15
New Hampshire	Sep-16	Jan-16
New Jersey	Nov-15	Nov-15
New Mexico	Nov-12	Sep-12
New York	Aug-13	Aug-13
North Carolina		
North Dakota		
Ohio	Apr-15	Dec-15
Oklahoma	Nov-15	Nov-15
Oregon		
Pennsylvania	Jun-15	Jun-15
Rhode Island	Mar-15	Jun-16
South Carolina	May-17	
South Dakota		
Tennessee	Apr-13	Apr-13
Texas	Sep-19	
Utah	May-17	
Vermont	Nov-13	May-15
Virginia	Jul-16	Jul-15
Washington		
West Virginia	May-13	Jun-12

Wisconsin	Apr-17	Apr-17
Wyoming		

Sources: National Alliance for Model State Drug Laws, “Mandated Use of State Prescription Drug Monitoring Programs (PMPS): Highlights of Key State Requirements,” Current as of June 30, 2017, <https://perma.cc/R8GT-BRT9> (archived August 19, 2019). PDAPS data are downloadable from <http://pdaps.org/datasets/prescription-monitoring-program-laws-1408223416-1502818373> (archived August 19, 2019 download available at <https://www.dropbox.com/s/a422f9e20pu1nk6/20170922.PDMP.Reporting.Stat.Data.xlsx?dl=0>) User must click “Data” icon and enter a name to get the data download. Dates in the online interactive tool may not correspond to downloadable database, depending on settings. If they do not, clicking on the time line within a conflicting state may expand the time line; it will then correspond with the database. (last checked July 22, 2019). We used Question 4, “Does the state require prescribers to check the PDMP before prescribing controlled substances?”

Notes: NAMSDL does not list dates for must query in the form of a database; it provides links to a separate page for each state that excerpts relevant statutory information from Westlaw. We coded the start date as the date listed on each page as the effective date, a date that a reasonable researcher would conclude is the start date.

**Table 3. Any Opioid Prescription Received in Calendar Year**

<b>Medicare Pop &lt;65 Years</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p- value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	-0.653	0.534	0.228	11,120,254
	NAMSDL	-0.633	0.539	0.246	10,640,443
	PDAPS	-0.519	0.595	0.387	11,120,254
<b>PDMP Operational</b>					
	Horwitz et al.	-0.557	0.355	0.124	11,120,254
	NAMSDL	-0.686	0.567	0.233	7,906,049
	NAMSDL, user access	-0.450	0.468	0.342	7,760,186
	PDAPS	-0.515	0.528	0.335	11,120,254
	PDAPS, user acces	0.169	0.412	0.684	7 565,930
<b>Must Query</b>					
	Horwitz et al.	-1.974	0.981	0.050	11,120,254
	NAMSDL	-3.589	0.428	0.000	7,906,049
	PDAPS	-2.196	0.852	0.013	11,120,254
Mean percent of beneficiaries filling any prescription for opioids = 45.28 (SD 49.78).					

<b>Total Medicare Population</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p-value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	-0.289	0.483	0.553	46,453,093
	NAMSDL	-0.410	0.503	0.419	44,218,007
	PDAPS	-0.483	0.499	0.339	46,453,093
<b>PDMP Operational</b>					
	Horwitz et al.	-0.042	0.285	0.883	46,453,093
	NAMSDL	-0.380	0.448	0.401	32,938,649
	NAMSDL, user access	0.482	0.370	0.200	32,195,060
	PDAPS	-0.428	0.467	0.365	46,453,093
	PDAPS, user acces	0.115	0.379	0.764	31,882,656
<b>Must Query</b>					
	Horwitz et al.	-0.996	0.952	0.301	46,453,093
	NAMSDL	-2.623	0.338	0.000	32,938,649
	PDAPS	-1.157	0.917	0.213	46,453,093
Mean percent of beneficiaries filling any prescription for opioids = 32.34 (SD 46.78).					

**Source:** Authors' calculations using Medicare Part D claims data for person-years from 2006 to 2014.

**Notes:** Table reports estimates from linear probability model of whether an individual Medicare beneficiary filled one or more opioid prescriptions in the year. Top panel includes ages 21 to 64 only, bottom panel includes ages 21 and older. Each row reflects a different model estimating any opioid fills as a function of whether a state had a prescription drug monitoring program in place in that year (estimates 1-3 use enactment date, estimates 4-8 use date when modern PDMP was operational, and estimates 9-11 show effect of state regulation requiring prescribers to query PDMP before prescribing opioids, while also controlling for date PDMP become operational). All models control for age (30-39, 40-49, 50-59, 60-64), black race, other nonwhite race, Hispanic ethnicity, female sex, the number of hierarchical condition categories used to adjust payments to Medicare part D drug plans (illness severity), and diagnosis of depression, whether beneficiary received any low income subsidy (proxy for poverty), Medicaid enrollment, indicators for each state, and indicators for each year. All regressions adjust for correlation of errors within states using Huber-White Sandwich estimators.

**Table 4. Annual Daily Morphine Equivalents Based on Opioid Prescriptions**

Medicare Pop <65 Years		Coefficient	Standard Error	p- value	N
<b>Legislation Enacted</b>					
	Horwitz et al.	2.476	1.651	0.140	11,120,254
	NAMSDL	3.594	1.843	0.057	10,640,443
	PDAPS	3.507	1.822	0.060	11,120,254
<b>PDMP Operational</b>					
	Horwitz et al.	-2.528	2.337	0.285	11,120,254
	NAMSDL	-6.270	4.393	0.162	7,906,049
	NAMSDL, user access	-0.716	2.299	0.757	7,760,186
	PDAPS	-5.404	4.057	0.189	11,120,254
	PDAPS, user acces	-2.487	2.203	0.266	7 565,930
<b>Must Query</b>					
	Horwitz et al.	-0.395	1.245	0.753	11,120,254
	NAMSDL	-2.303	1.346	0.095	7,906,049
	PDAPS	-2.163	1.215	0.081	11,120,254
<b>Mean daily morphine equivalents based on opioid prescription fills 20.6 mg (SD 1196.2).</b>					

Total Medicare Population		Coefficient	Standard Error	p-value	N
<b>Legislation Enacted</b>					
	Horwitz et al.	0.698	0.575	0.231	46,453,093
	NAMSDL	0.933	0.618	0.138	44,218,007
	PDAPS	0.704	0.593	0.241	46,453,093
<b>PDMP Operational</b>					
	Horwitz et al.	-0.248	0.606	0.684	46,453,093
	NAMSDL	-1.296	1.093	0.243	32,938,649
	NAMSDL, user access	0.332	0.652	0.614	32,195,060
	PDAPS	-1.192	0.977	0.228	46,453,093
	PDAPS, user access	-0.086	0.561	0.879	31,882,656
<b>Must Query</b>					
	Horwitz et al.	-0.288	0.483	0.554	46,453,093
	NAMSDL	-1.271	0.685	0.071	32,938,649
	PDAPS	-0.740	0.446	0.104	46,453,093
<b>Mean daily morphine equivalents based on opioid prescription fills = 7.99 mg (SD 591.8).</b>					

**Source:** Authors' calculations using Medicare Part D claims data for person-years from 2006 to 2014.

**Notes:** Table reports estimates from OLS model of annual morphine equivalents per day based on opioid prescription fills. Top panel includes ages 21 to 64 only, bottom panel includes ages 21 and older. Each row reflects a different model estimating any opioid fills as a function of whether a state had a prescription drug monitoring program in place in that year (estimates 1-3 use enactment date, estimates 4-8 use date when modern PDMP was operational, and estimates 9-11 show effect of state regulation requiring prescribers to query PDMP before prescribing opioids, while also controlling for date PDMP become operational). All models control for age (30-39, 40-49, 50-59, 60-64), black race, other nonwhite race, Hispanic ethnicity, female sex, the number of hierarchical condition categories used to adjust payments to Medicare part D drug plans (illness severity), and diagnosis of depression, whether beneficiary received any low income subsidy (proxy for poverty), Medicaid enrollment, indicators for each state, and indicators for each year. All regressions adjust for correlation of errors within states using Huber-White Sandwich estimators.

**Table 5. High Dose Opioids (>120 mg daily morphine equivalents in any quarter)**

<b>Medicare Pop &lt;65 Years</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p- value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	0.095	0.216	0.660	11,120,254
	NAMSDL	0.232	0.284	0.417	10,640,443
	PDAPS	0.201	0.299	0.504	11,120,254
<b>PDMP Operational</b>					
	Horwitz et al.	0.143	0.176	0.420	11,120,254
	NAMSDL	-0.059	0.274	0.830	7,906,049
	NAMSDL, user access	0.153	0.232	0.515	7,760,186
	PDAPS	-0.034	0.232	0.883	11,120,254
	PDAPS, user acces	0.143	0.244	0.562	7 565,930
<b>Must Query</b>					
	Horwitz et al.	0.346	0.311	0.271	11,120,254
	NAMSDL	-0.355	0.245	0.155	7,906,049
	PDAPS	0.297	0.342	0.388	11,120,254
<b>Mean percent with daily morphine equivalents in quarter above 120 mg= 4.5 (SD 22.8).</b>					

<b>Total Medicare Population</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p-value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	0.103	0.167	0.539	46,453,093
	NAMSDL	0.081	0.206	0.695	44,218,007
	PDAPS	-0.016	0.189	0.931	46,453,093
<b>PDMP Operational</b>					
	Horwitz et al.	0.203	0.103	0.053	46,453,093
	NAMSDL	0.032	0.203	0.874	32,938,649
	NAMSDL, user access	0.257	0.140	0.074	32,195,060
	PDAPS	-0.009	0.167	0.955	46,453,093
	PDAPS, user acces	0.250	0.132	0.066	31,882,656
<b>Must Query</b>					
	Horwitz et al.	0.151	0.229	0.513	46,453,093
	NAMSDL	-0.187	0.199	0.354	32,938,649
	PDAPS	0.134	0.260	0.609	46,453,093
<b>Mean percent with daily morphine equivalents in quarter above 120 mg= 2.1 (SD 14.4).</b>					

**Source:** Authors' calculations using Medicare Part D claims data for person-years from 2006 to 2014.

**Notes:** Table reports estimates from linear probability model of whether an individual Medicare beneficiary filled opioid prescriptions in one or more quarters yielding above 120 mg morphine equivalents daily. Top panel includes ages 21 to 64 only, bottom panel includes ages 21 and older. Each row reflects a different model estimating any opioid fills as a function of whether a state had a prescription drug monitoring program in place in that year (estimates 1-3 use enactment date, estimates 4-8 use date when modern PDMP was operational, and estimates 9-11 show effect of state regulation requiring prescribers to query PDMP before prescribing opioids, while also controlling for date PDMP become operational). All models control for age (30-39, 40-49, 50-59, 60-64), black race, other nonwhite race, Hispanic ethnicity, female sex, the number of hierarchical condition categories used to adjust payments to Medicare part D drug plans (illness severity), and diagnosis of depression, whether beneficiary received any low income subsidy (proxy for poverty), Medicaid enrollment, indicators for each state, and indicators for each year. All regressions adjust for correlation of errors within states using Huber-White Sandwich estimators.

**Table 6. Opioid Prescriptions Filled at More than Four Pharmacies in Year**

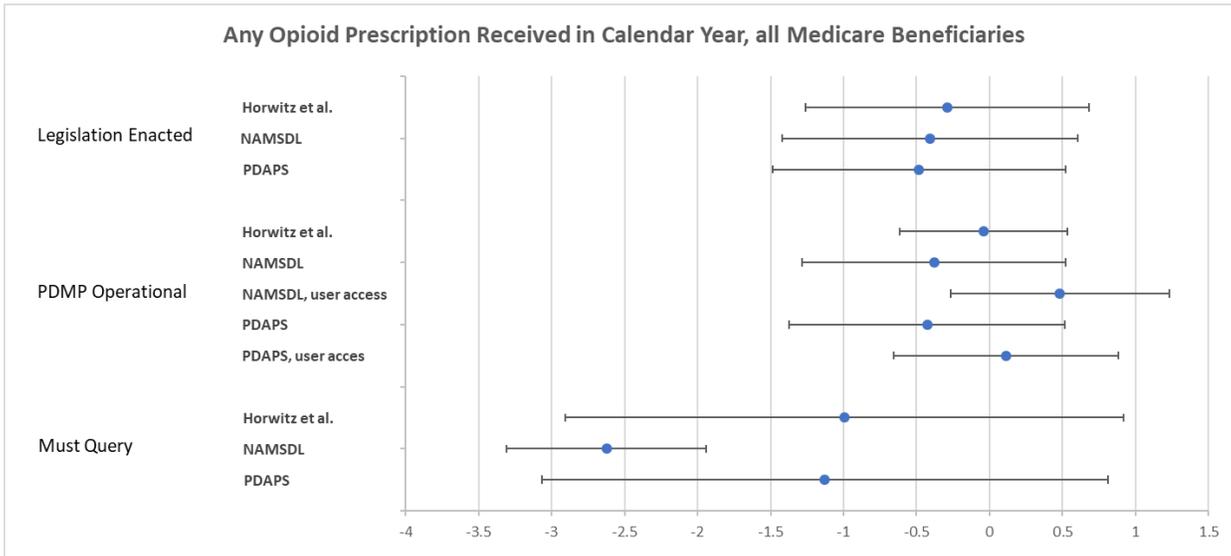
<b>Medicare Pop &lt;65 Years</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p- value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	0.054	0.080	0.507	11,120,254
	NAMSDL	0.174	0.090	0.061	10,640,443
	PDAPS	0.199	0.091	0.034	11,120,254
<b>PDMP Operational</b>					
	Horwitz et al.	-0.098	0.060	0.110	11,120,254
	NAMSDL	-0.011	0.100	0.912	7,906,049
	NAMSDL, user access	-0.073	0.092	0.438	7,760,186
	PDAPS	0.026	0.086	0.765	11,120,254
	PDAPS, user acces	0.008	0.092	0.930	7 565,930
<b>Must Query</b>					
	Horwitz et al.	-0.293	0.167	0.085	11,120,254
	NAMSDL	-0.471	0.209	0.030	7,906,049
	PDAPS	-0.256	0.146	0.087	11,120,254
Percent of beneficiaries filling opioid prescriptions at more than 4 pharmacies =1.69 (SD 12.9).					

<b>Total Medicare Population</b>		<b>Coefficient</b>	<b>Standard Error</b>	<b>p-value</b>	<b>N</b>
<b>Legislation Enacted</b>					
	Horwitz et al.	0.013	0.022	0.555	46,453,093
	NAMSDL	0.037	0.022	0.101	44,218,007
	PDAPS	0.039	0.022	0.078	46,453,093
<b>PDMP Operational</b>					
	Horwitz et al.	-0.024	0.016	0.147	46,453,093
	NAMSDL	-0.006	0.026	0.827	32,938,649
	NAMSDL, user access	-0.017	0.025	0.496	32,195,060
	PDAPS	-0.002	0.023	0.926	46,453,093
	PDAPS, user acces	0.009	0.026	0.740	31,882,656
<b>Must Query</b>					
	Horwitz et al.	-0.064	0.068	0.345	46,453,093
	NAMSDL	-0.143	0.077	0.070	32,938,649
	PDAPS	-0.056	0.060	0.353	46,453,093
Percent of beneficiaries filling opioid prescriptions at more than 4 pharmacies =0.48 (SD 6.9).					

**Source:** Authors' calculations using Medicare Part D claims data for person-years from 2006 to 2014.

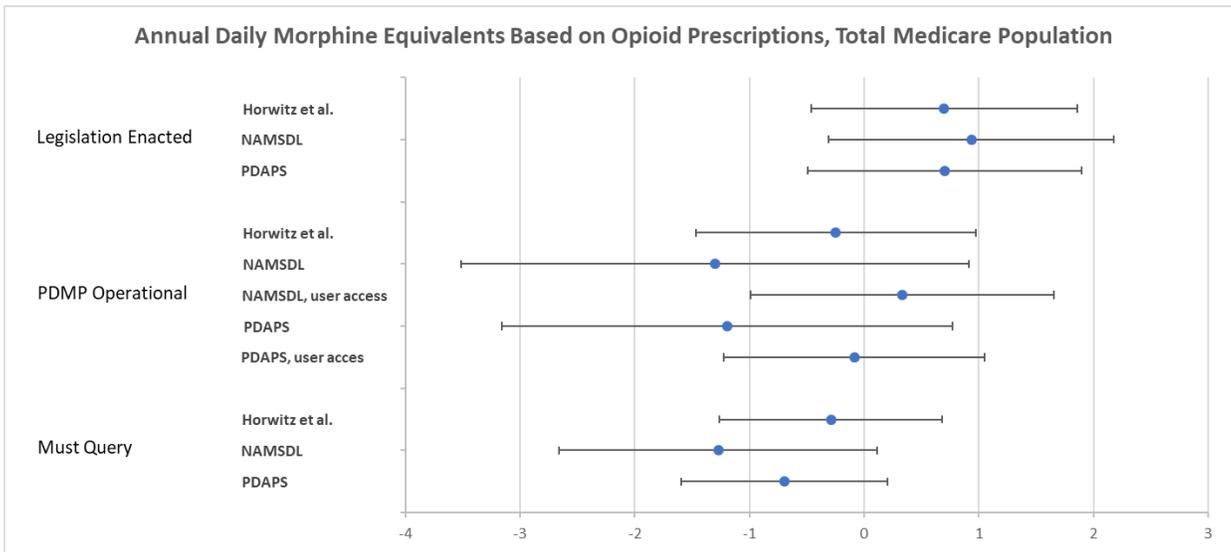
**Notes:** Table reports estimates from linear probability model of whether an individual Medicare beneficiary filled opioid prescriptions at more than four pharmacies. Top panel includes ages 21 to 64 only, bottom panel includes ages 21 and older. Each row reflects a different model estimating any opioid fills as a function of whether a state had a prescription drug monitoring program in place in that year (estimates 1-3 use enactment date, estimates 4-8 use date when modern PDMP was operational, and estimates 9-11 show effect of state regulation requiring prescribers to query PDMP before prescribing opioids, while also controlling for date PDMP become operational). All models control for age (30-39, 40-49, 50-59, 60-64), black race, other nonwhite race, Hispanic ethnicity, female sex, the number of hierarchical condition categories used to adjust payments to Medicare part D drug plans (illness severity), and diagnosis of depression, whether beneficiary received any low income subsidy (proxy for poverty), Medicaid enrollment, indicators for each state, and indicators for each year. All regressions adjust for correlation of errors within states using Huber-White Sandwich estimators.

Figure 1. Any Opioid Prescription Received in Calendar Year Among all Medicare, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



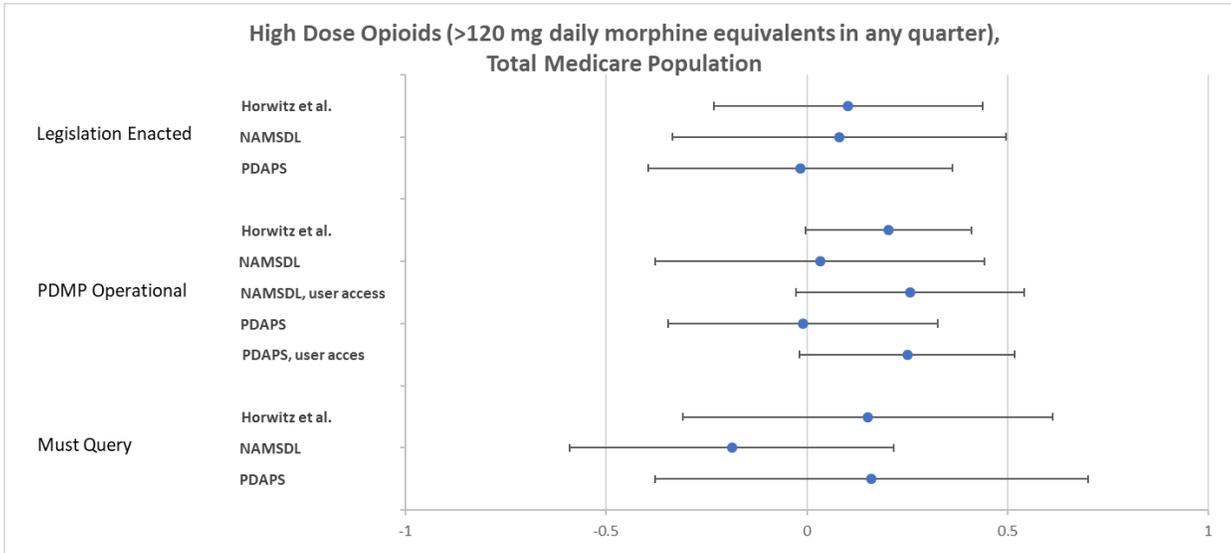
Notes: Mean percent of beneficiaries filling any prescription for opioids = 32.34 (SD 46.78).

Figure 2. Annual Daily Morphine Equivalents Based on Opioid Prescriptions Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



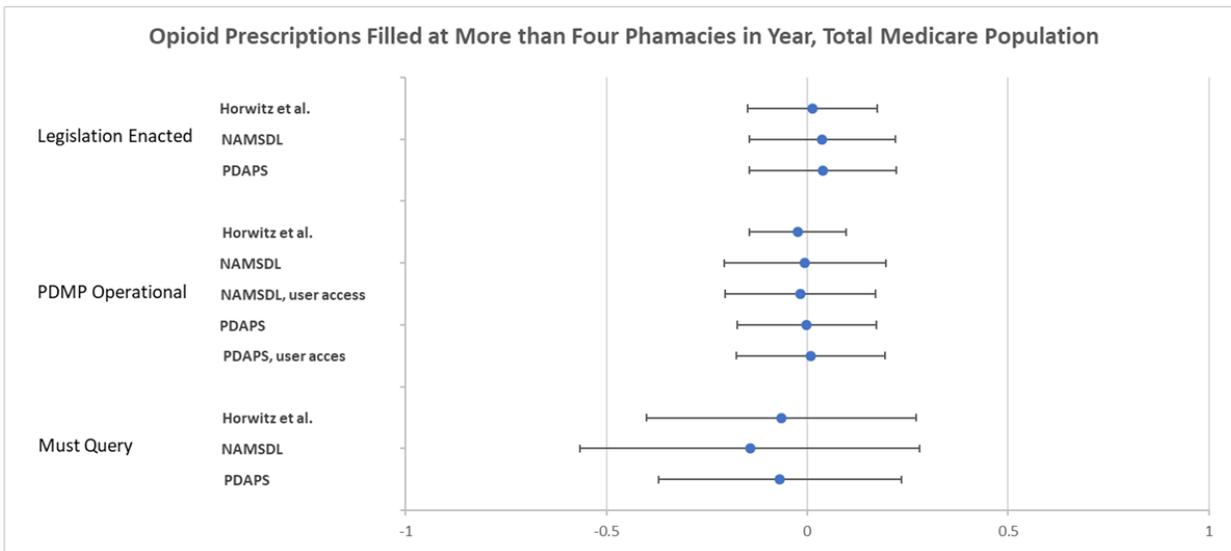
Notes: Mean daily morphine equivalents based on opioid prescription fills 7.99 mg (SD 591.8).

**Figure 3.** High Dose Opioids (>120 mg daily morphine equivalents in any quarter) Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



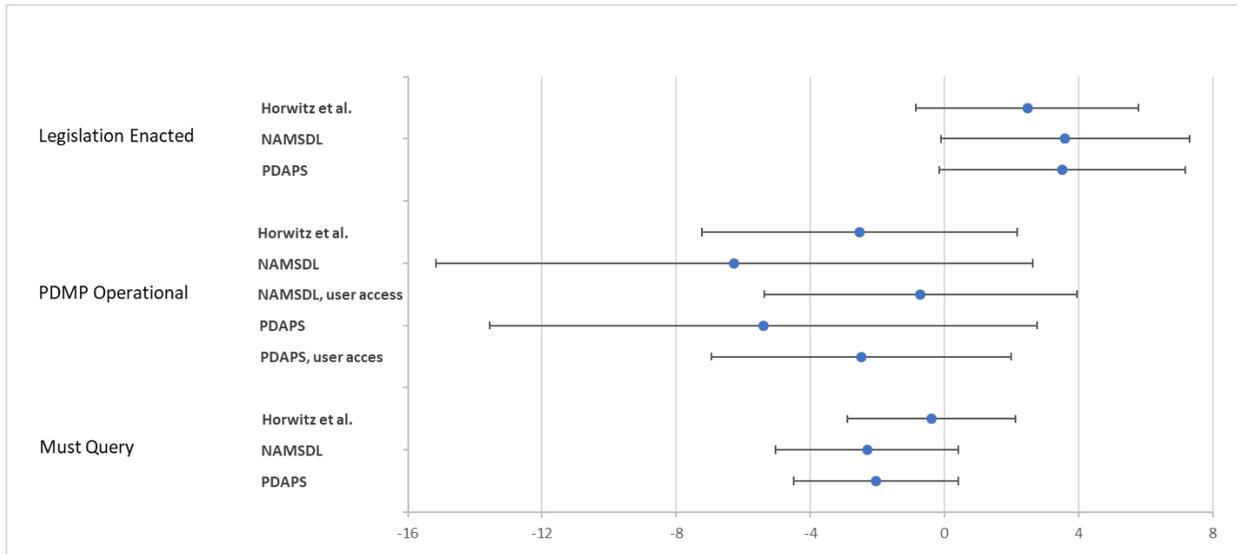
Notes: Mean percent with daily morphine equivalents in quarter above 120 mg= 2.1 (SD 14.4).

**Figure 4.** Opioid Prescriptions Filled at More than Four Pharmacies in Year Among Medicare Beneficiaries, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



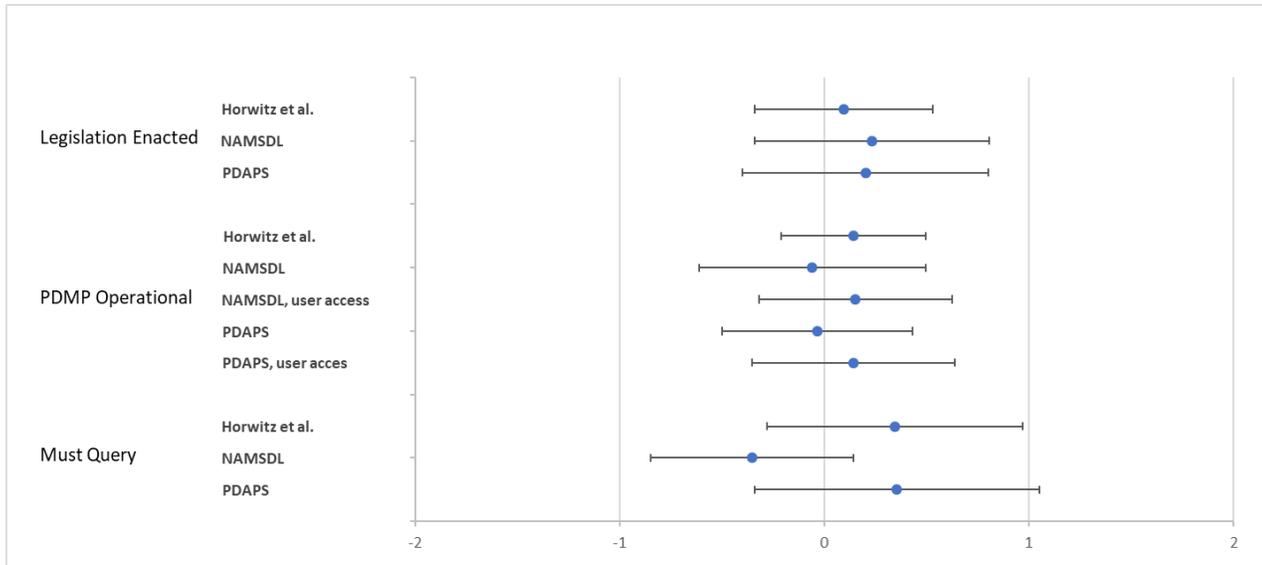
Notes: Percent of beneficiaries filling opioid prescriptions at more than 4 pharmacies =0.48 (SD 6.9).

**Figure 5.** Annual Daily Morphine Equivalents Based on Opioid Prescriptions Among Medicare Beneficiaries Under Age 65, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



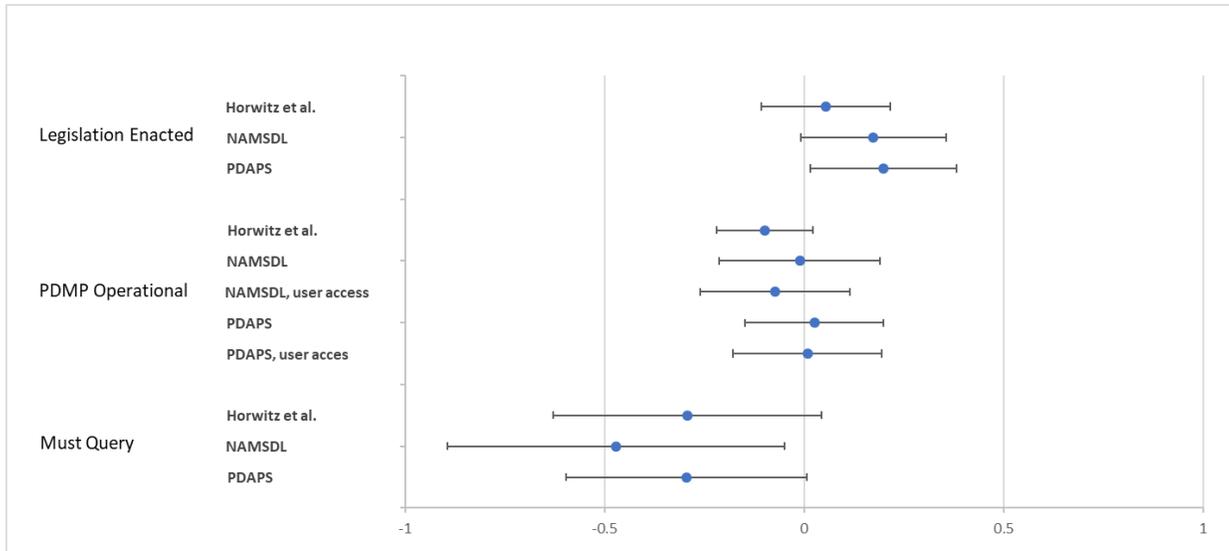
Notes: Mean daily morphine equivalents based on opioid prescription fills 20.6 mg (SD 1196.2).

**Figure 6.** High Dose Opioids (>120 mg daily morphine equivalents in any quarter) Among Medicare Beneficiaries Under Age 65, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



Notes: Mean percent with daily morphine equivalents in quarter above 120 mg= 4.5 (SD 22.8).

**Figure 7.** Opioid Prescriptions Filled at More than Four Pharmacies in Year Among Medicare Beneficiaries Under Age 65, Percentage Point Change When PDMP is Enacted, Operational, or Requires Query



Notes: Percent of beneficiaries filling opioid prescriptions at more than 4 pharmacies = 1.69 (SD 12.9).