Supplementary Online Content

Chua KP, Waljee JF, Smith MA, Bahl S, Nalliah RP, Brummett CM. Estimation of the prevalence of delayed dispensing among opioid prescriptions from US surgeons and dentists. *JAMA Netw Open*. 2022;5(5):e2214311. doi:10.1001/jamanetworkopen.2022.14311

**eAppendix 1.** List of Opioid Analgesics Included  
**eAppendix 2.** Search Strategy for State Laws  
**eAppendix 3.** List of Laws Regulating the Maximum Period Between Writing and Dispensing of Controlled Substance Prescriptions  
**eAppendix 4.** Prevalence of Delayed Dispensing Among Opioid Prescriptions From Surgeons and Dentists in 2019 by State, Using IQVIA Formulary Impact Analyzer Data  
**eAppendix 5.** Prevalence of Delayed Dispensing Among Opioid Prescriptions Dispensed in 2019, by Specialty  
**eAppendix 6.** Sensitivity Analyses for Difference-in-Differences Analyses

This supplementary material has been provided by the authors to give readers additional information about their work.
eAppendix 1. List of Opioid Analgesics Included

Opioid analgesics included benzhydrocodone, buprenorphine, butorphanol, codeine, dihydrocodeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, nalbuphine, opium, oxycodone, oxymorphone, pentazocine, propoxyphene, sufentain, tapentadol, and tramadol. Buprenorphine formulations approved for opioid use disorder were excluded, as were opioid cough-and-cold medications.
eAppendix 2. Search Strategy for State Laws

Laws regulating maximum period between writing and dispensing of controlled substance prescriptions

During winter 2021, we used NABPLAW Online to compile all state laws regulating the maximum period between writing and dispensing of controlled substance prescriptions that were effective at the time of the search. We started with NABPLAW Online as opposed to WestLaw Edge because the former only contained pharmacy laws, making the relevant laws easier to identify. We used the following search terms in NABPLAW for each of the 50 states and the District of Columbia (the example below is for Alabama):

- “controlled substance” “day” “AL”
- “controlled substance” “month” “AL”
- “controlled substance” “year” “AL”
- “Schedule II” “day” “AL”; “Schedule II” “month” “AL”; “Schedule II” “year” “AL”
- “Schedule III” “day” “AL”; “Schedule III” “month” “AL”; “Schedule III” “year” “AL”
- “Schedule IV” “day” “AL”; “Schedule IV” “month” “AL”; “Schedule IV” “year” “AL”
- “Schedule V” “day” “AL”; “Schedule V” “month” “AL”; “Schedule V” “year” “AL”

Of 180 state laws identified, we excluded laws that only applied to partial refills, laws that only applied to patients in long-term care facilities, laws that only apply to disciplinary measures for violations of regulations surrounding controlled substance prescribing regulations, and laws that were not applicable to the pharmacy setting. The 96 remaining laws all pertained to the maximum period between writing and dispensing of controlled substance prescriptions.

Although NABPLAW included the text of the current 96 laws along with the dates of amendments, it did not contain the text of the amendments. Therefore, we used Thomas Reuters Westlaw Edge to compile the text and effective dates of all amendments. By comparing the text of the law effective as of the time of the search and any amendments, we determined which laws were effective as of December 31, 2019 and whether states had passed laws regulating the maximum period between writing and dispensing of controlled substance prescriptions between 2014-2019 (for the difference-in-differences analysis).

We conducted two additional checks to ensure that we had identified all relevant laws. First, we used the same search terms as above in WestLaw Edge and obtained the same set of laws. Second, we used more general search terms to search for relevant laws for each state in WestLaw Edge: “controlled substance”, “Schedule II”, “Schedule III”, “Schedule IV”, “Schedule V.” This strategy yielded the same set of laws as in our original search of NABPLAW.

Laws regulating maximum period between writing and dispensing of non-controlled substance prescriptions

When states did not have specific laws regulating the maximum period between writing and dispensing of controlled substances in DEA Schedule III-IV, we set the maximum period to 6 months, the maximum allowed under the Controlled Substance Act.

When states did not have specific laws regulating the maximum period between writing and dispensing of controlled substances in DEA Schedule II or V, we set the maximum period to the period allowed for non-controlled substance prescriptions by the state. To identify state laws regulating this period for non-controlled substance prescriptions, we used WestLaw Edge and additionally contacted state pharmacy associations.
**eAppendix 3. List of Laws Regulating the Maximum Period Between Writing and Dispensing of Controlled Substance Prescriptions**

| State     | Law                                                                 |
|-----------|----------------------------------------------------------------------|
| Alabama   | Ala.Code 1975 § 20-2-58                                              |
|           | AK Rule 12 AAC 52.470                                                |
| Arizona   | A.R.S. § 36-2525                                                     |
|           | A.R.S. § 32-1968                                                     |
| Arkansas  | Ark. Admin. Code 070.00.7-07-04-0004                                 |
|           | Ark. Admin. Code 007.07.2-I-IX                                       |
|           | Ark. Admin. Code 007.07.2-II-VIII                                    |
|           | A.C.A. § 5-64-308                                                    |
|           | AR Rule 070.00.7-07-02-0002                                          |
| California| West's Ann.Cal.Health & Safety Code § 11200                         |
|           | West's Ann.Cal.Health & Safety Code § 11166                         |
| Colorado  | C.R.S.A. § 18-18-308                                                 |
|           | CO Rule 719-1:3.00.00                                                |
| Connecticut| C.G.S.A. § 21a-249                                                   |
| Delaware  | 24 Del. Admin. Code CSA 4.0                                          |
|           | 16 Del.C. § 4739                                                     |
|           | DE Rule 2500-5.0                                                     |
| D.C.      | DC ST § 48-903.08                                                    |
|           | 22-B DCMR § 1310                                                     |
| Florida   | Section 22-B1325., 1325.8                                            |
|           | West's F.S.A. § 465.0276                                             |
|           | West's F.S.A. § 893.04                                               |
|           | Rule 64B16-27.211, F.A.C.                                           |
|           | FL Rule 64B16-27.211                                                |
| Georgia   | Ga Comp. R. & Regs. 480-21-.05                                       |
|           | Ga Comp. R. & Regs. 480-22-.08                                       |
|           | Ga. Code Ann., § 16-13-41                                             |
|           | Ga. Code Ann., § 26-4-80                                              |
|           | GA Rule 480-22-.12                                                   |
| Hawaii    | HRS § 329-38                                                         |
|           | HI Law 328-16                                                        |
|           | Haw. Admin. Rules (HAR) § 23-200-15                                   |
| Idaho     | I.C. § 37-2722                                                       |
| Illinois  | 720 ILCS 570/312                                                     |
|           | 410 ILCS 620/2.36                                                    |
| Indiana   | 856 IAC 2-6-13                                                       |
|           | IC 35-48-3-9                                                         |
|           | IN Rule 856 IAC Rule 1-32-2                                          |
| Iowa      | I.C.A. § 124.308                                                     |
|           | Iowa Admin. Code 657-10.24(124,126,155A)                              |
|           | Iowa Admin. Code 657-10.32(124)                                      |
|           | IA Rule 657-7.11. (124,126,155A)                                     |
|           | IA Law 155A.29                                                       |
| Kansas    | K.A.R. 68-20-19                                                      |
|           | KAR 68-20-20                                                         |
|           | K.S.A. 65-4123                                                       |

© 2022 Chua KP et al. *JAMA Network Open.*
| State       | Code/Regulations                                                                 |
|------------|----------------------------------------------------------------------------------|
| Kentucky   | K.S.A. 65-1637                                                                   |
| Louisiana  | KY Law 218A.180                                                                  |
|            | 201 KAR 2:185                                                                   |
|            | La. Admin Code, tit. 46, Pt LIII, § 2745                                          |
|            | LSA-R.S. 40:978                                                                  |
| Maine      | La. Admin Code, tit. 46, Pt LIII, § 2747                                          |
|            | La. Admin Code, tit. 46, Pt LIII, § 2525                                          |
|            | La. Admin Code, tit. 50, Pt XXIX, § 117                                           |
|            | 02-392 CMR Ch. 19, § 2                                                           |
|            | 02-392 CMR Ch. 19, § 5                                                           |
| Maryland   | COMAR 10.19.03.08                                                                 |
|            | COMAR 10.19.03.09                                                                 |
|            | MD Code, Health Occupations, § 12-503.                                           |
| Massachusetts | M.G.L.A. 94C § 23                                                              |
|            | M.G.L.A. 94C § 18                                                               |
| Michigan   | M.C.L.A. 333.7333                                                                |
|            | Mich. Admin. Code R 338.584                                                      |
| Minnesota  | M.S.A. § 152.11                                                                  |
|            | Law 151.211                                                                     |
|            | Minnesota Rules, part 6800.3510                                                   |
| Mississippi | 30 Miss. Admin. Code Pt. 3001, Art. XIX                                          |
|            | 30 Miss. Admin. Code Pt. 3001, Art. XII                                          |
|            | Miss. Code Ann. § 41-29-137                                                      |
|            | 30 Miss. Admin. Code Pt. 3001, Art. XXI                                          |
|            | 30 Miss. Admin. Code Pt. 2640, R. 1.11                                           |
| Missouri   | V.A.M.S. 195.060                                                                 |
|            | MO Rule 19 CSR 30-1.064                                                          |
|            | 20 CSR 2220-2.110                                                                |
| Montana    | MCA 50-32-208                                                                   |
|            | Mont.Admin.R. 24.174.831                                                          |
| Nebraska   | Neb.Rev.St. § 28-414                                                              |
|            | Neb. Admin. R. & Regs. Tit. 175, Ch. 8, § 006                                      |
|            | Neb.Rev.St. § 28-414.01                                                           |
| Nevada     | Neb.Rev.St. § 38-2870                                                             |
|            | NE Rule 175-8-006                                                                |
|            | N.R.S. 453.431                                                                  |
|            | N.R.S. 639.2393                                                                  |
|            | N.R.S. 453.256                                                                  |
| New Hampshire | N.H. Rev. Stat. § 318-B:9                                                      |
|            | N.H. Code Admin. R. Ph 704.14                                                    |
| New Jersey | N.J.A.C. 13:45H–7.5                                                              |
|            | N.J.A.C. 13:45H–7.14                                                             |
|            | N.J.S.A. 24:21–15                                                                |
|            | N.J.A.C. 13:39–7.3                                                               |
|            | NJ Rule 13-45H-7.15                                                              |
| New Mexico | N.M. Admin. Code 16.19.20.45                                                     |
|            | N. M. S. A. 1978, § 30-31-18                                                      |
|            | N. M. S. A. 1978, § 26-1-16                                                      |
| New York   | 10 NYCRR 80.73                                                                  |
|            | McKinney's Public Health Law § 3333                                              |
| Region       | Codes and References |
|--------------|-----------------------|
| North Carolina | N.C.G.S.A. § 90-106  
N.C.G.S.A. § 90-85.32 |
| North Dakota  | NDCC. 19-03.1-22  
NDCC. 19-02.1-15 |
| Ohio         | R.C. § 3719.05    
R.C. § 4729.281 |
| Oklahoma      | Okla. Admin. Code 475:30-1-4  
Okla. Admin. Code 475:30-1-11  
63 Okl.St.Ann. § 2-309  
OK Rule 535:15-3-12  
OK Rule 535:15-3-11 |
| Oregon        | OAR 855-041-1125  
49 Pa. Code § 27.18  
35 P.S. § 780-111  
Gen.Laws 1956, § 21-28-3.18  
216-RICR-40-15-1.4 |
| Pennsylvania  | Code 1976 § 44-53-360  
S.C. Code of Regulations R. 61-4.1102  
S.C. Code of Regulations R. 61-4.1202  
Code 1976 § 40-43-86 |
| Rhode Island  | T. C. A. § 53-11-308  
Tenn. Comp. R. & Regs. 1140-03-.03  
22 TAC § 315.3  
22 TAC § 315.5  
V.T.C.A., Health & Safety Code § 481.074  
22 TAC § 291.34 |
| South Carolina| ARSD 44:58:08:17  
T. C. A. § 53-11-308  
22 TAC § 315.3  
22 TAC § 315.5  
V.T.C.A., Health & Safety Code § 481.074  
22 TAC § 291.34 |
| South Dakota  | ARSD 44:58:08:17  
T. C. A. § 53-11-308  
22 TAC § 315.3  
22 TAC § 315.5  
V.T.C.A., Health & Safety Code § 481.074  
22 TAC § 291.34 |
| Tennessee     | U.C.A. 1953 § 58-37-6  
U.A.C. R156-37-603  
U.C.A. 1953 § 58-17b-609 |
| Texas         | U.A.C. 1953 § 58-17b-609  
22 TAC § 315.3  
22 TAC § 315.5  
V.T.C.A., Health & Safety Code § 481.074 |
| Utah          | Vt. Admin. Code 20-4-1400:10.16  
Vt. Admin. Code 12-5-53:8.0  
Vt. Admin. Code 20-4-1400:10.17 |
| Vermont       | T. C. A. § 53-11-308  
Tenn. Comp. R. & Regs. 1140-03-.03  
22 TAC § 315.3  
22 TAC § 315.5  
V.T.C.A., Health & Safety Code § 481.074  
22 TAC § 291.34 |
| Virginia      | U.A.C. 1953 § 58-37-6  
U.A.C. R156-37-603  
U.C.A. 1953 § 58-17b-609  
Vt. Admin. Code 20-4-1400:10.16  
Vt. Admin. Code 12-5-53:8.0  
Vt. Admin. Code 20-4-1400:10.17 |
| Washington    | 18 VAC 110-20-290  
18 VAC 110-20-320  
West's RCWA 69.50.308  
WAC 246-887-020  
WAC 246-945-012 |
| West Virginia | W. Va. Code St. R. § 15-2-8  
W. Va. Code St. R. § 15-1-7  
WV Law 60A-3-308 |
| Wisconsin     | Wis. Adm. Code § Phar 8.05  
W.S.A. 961.38 |
| Wyoming       | Wis. Adm. Code § Phar 8.06  
Wis. Adm. Code § Phar 7.03  
WY Rules and Regulations 059.0002.6 § 13 |
WY Rules and Regulations 059.0002.6 § 20
WY Rule 059.0002.10 Sec. 7
WY Rule 059.0002.10 Sec. 3
W.S.1977 § 33-24-101
**eAppendix 4. Prevalence of Delayed Dispensing Among Opioid Prescriptions From Surgeons and Dentists in 2019 by State, Using IQVIA Formulary Impact Analyzer Data**

| Group                                      | Number of prescriptions dispensed in 2019 | Number of prescriptions with delayed dispensing (% of all prescriptions in state) |
|--------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------|
| All prescriptions in sample                | 20,858,413                               | 194,452 (0.9%)                                                                |
| State                                      |                                          |                                                                                 |
| Alabama                                    | 737,176                                  | 13,989 (1.9%)                                                                 |
| Alaska                                     | 54,338                                   | 209 (0.4%)                                                                     |
| Arizona                                    | 450,399                                  | 2,913 (0.6%)                                                                   |
| Arkansas                                    | 419,950                                  | 7,082 (1.7%)                                                                   |
| California                                  | 1,339,879                                | 18,778 (1.4%)                                                                  |
| Colorado                                   | 526,996                                  | 7,693 (1.5%)                                                                   |
| Connecticut                                | 125,490                                  | 343 (0.3%)                                                                     |
| Delaware                                   | 58,675                                   | 97 (0.2%)                                                                      |
| District of Columbia                        | 23,948                                   | 189 (0.8%)                                                                     |
| Florida                                    | 1,389,461                                | 19,110 (1.4%)                                                                  |
| Georgia                                    | 1,006,683                                | 13,337 (1.3%)                                                                  |
| Hawaii                                     | 30,926                                   | 40 (0.1%)                                                                      |
| Idaho                                      | 173,963                                  | 935 (0.5%)                                                                     |
| Illinois                                   | 813,048                                  | 8,704 (1.1%)                                                                   |
| Indiana                                    | 439,111                                  | 2,769 (0.6%)                                                                   |
| Iowa                                       | 196,543                                  | 936 (0.5%)                                                                     |
| Kansas                                     | 255,647                                  | 2,574 (1.0%)                                                                   |
| Kentucky                                   | 504,036                                  | 2,316 (0.5%)                                                                   |
| Louisiana                                  | 657,254                                  | 9,911 (1.5%)                                                                   |
| Maine                                      | 48,215                                   | 52 (0.1%)                                                                      |
| Maryland                                   | 258,092                                  | 2,471 (1.0%)                                                                   |
| Massachusetts                              | 167,121                                  | 376 (0.2%)                                                                     |
| Michigan                                   | 603,135                                  | 4,581 (0.8%)                                                                   |
| Minnesota                                  | 245,053                                  | 643 (0.3%)                                                                     |
| Mississippi                                | 355,501                                  | 2,598 (0.7%)                                                                   |
| Missouri                                   | 623,077                                  | 3,830 (0.6%)                                                                   |
| Montana                                    | 83,873                                   | 463 (0.6%)                                                                     |
| Nebraska                                   | 134,448                                  | 671 (0.5%)                                                                     |
| Nevada                                     | 161,227                                  | 698 (0.4%)                                                                     |
| New Hampshire                              | 56,407                                   | 514 (0.9%)                                                                     |
| New Jersey                                 | 350,786                                  | 533 (0.2%)                                                                     |
| New Mexico                                 | 140,668                                  | 1,789 (1.3%)                                                                   |
| New York                                   | 577,659                                  | 331 (0.1%)                                                                     |
| North Carolina                             | 611,043                                  | 6,463 (1.1%)                                                                   |
| North Dakota                               | 43,026                                   | 215 (0.5%)                                                                     |
| Ohio                                       | 812,293                                  | 2,221 (0.3%)                                                                   |
| Oklahoma                                   | 514,909                                  | 497 (0.1%)                                                                     |
| Oregon                                     | 343,910                                  | 5,857 (1.7%)                                                                   |
| Pennsylvania                               | 571,177                                  | 6,409 (1.1%)                                                                   |
| Rhode Island                               | 28,040                                   | 127 (0.5%)                                                                     |

© 2022 Chua KP et al. JAMA Network Open.
| State               | Population | Cases   | (%)  |
|---------------------|------------|---------|------|
| South Carolina      | 367,540    | 3,574   | 1.0% |
| South Dakota        | 65,017     | 218     | 0.3% |
| Tennessee           | 772,784    | 6,355   | 0.8% |
| Texas               | 1,884,032  | 13,179  | 0.7% |
| Utah                | 274,141    | 1,613   | 0.6% |
| Vermont             | 23,127     | 229     | 1.0% |
| Virginia            | 423,219    | 5,750   | 1.4% |
| Washington          | 593,296    | 7,244   | 1.2% |
| West Virginia       | 131,476    | 1,317   | 1.0% |
| Wisconsin           | 333,971    | 1,372   | 0.4% |
**eAppendix 5. Prevalence of Delayed Dispensing Among Opioid Prescriptions Dispensed in 2019, by Specialty**

| Group                  | Number of prescriptions dispensed in 2019<sup>a</sup> | Number of prescriptions with delayed dispensing (% of all prescriptions in specialty) |
|------------------------|------------------------------------------------------|--------------------------------------------------------------------------------------|
| All prescriptions in sample | 101,991,162                                        | 5,915,854 (5.8%)                                                                   |
| Specialty              |                                                      |                                                                                     |
| Emergency medicine     | 3,649,507                                            | 25,063 (0.7%)                                                                       |
| Family medicine        | 19,427,204                                           | 1,392,974 (7.1%)                                                                   |
| Internal medicine      | 12,309,427                                           | 693,048 (5.6%)                                                                      |
| Nurse practitioner     | 13,068,710                                           | 821,951 (6.3%)                                                                      |
| Osteopathy             | 13,601                                               | 336 (2.5%)                                                                          |
| Pain medicine          | 7,699,959                                            | 975,473 (12.7%)                                                                    |
| Physician assistant    | 9,793,181                                            | 536,523 (5.5%)                                                                      |
| Other                  | 15,120,336                                           | 1,275,508 (8.4%)                                                                   |
| Unknown                | 50,824                                               | 526 (1.0%)                                                                          |
| Surgery                | 13,214,367                                           | 127,786 (1.0%)                                                                     |
| Dentistry              | 7,644,046                                            | 66,666 (0.9%)                                                                       |

<sup>a</sup>These prescriptions met all study inclusion and exclusion criteria (e.g., they were not refills of prior prescriptions) except that they were written by any prescriber, as opposed to surgeons and dentists specifically.
eAppendix 6. Sensitivity Analyses for Difference-in-Differences Analyses

For prescription $i$ dispensed in state $s$ during month $t$, the model specification in the main analysis was:

$$E(Y_{ist}) = \beta_1 \text{State}_s + \beta_2 \text{Month}_t + \beta_3 \text{Minnesota}_{ist} \times \text{Post}_{ist}$$

Where $Y_{ist}$ is an indicator that equals 1 if the prescription was dispensed more than 30 days after writing and 0 otherwise, Minnesota is an indicator that equals 1 if the prescription was dispensed to a patient residing in Minnesota and 0 if dispensed to a patient in a control state, and Post is an indicator that equals 1 if the prescription was dispensed on or after July 1, 2019 (the date on which Minnesota’s law was enacted) and 0 otherwise. State is a vector of state fixed effects (accounting for time-invariant confounders at the state level) and month is a vector of year-month fixed effects (accounting for confounders associated with specific time periods). Models employed standard errors clustered at the state level.

Analyses excluded nine states that restricted the maximum period between writing and dispensing of prescriptions for Schedule II, III, or IV drugs to 30 days or less. Analyses also excluded Louisiana, New Mexico, and Florida, the last of which prohibited dispensing of prescriptions for Schedule II-III drugs more than 14 days after the date of a surgical procedure. The remaining 38 states were control states.

We conducted several sensitivity analyses, all of which yielded similar difference-in-differences estimates as in the main analysis (-0.22 percentage points, 95% CI: -0.32, -0.13).

- Controlled for patient age, patient sex, DEA Schedule, whether prescription was written by a surgeon or dentist, and prescription method of payment: -0.23 (-0.33, -0.14).
- Used standard errors clustered at the patient level instead of state level: -0.22 (-0.25, -0.20).
- Limited to data from 2017-2019: -0.22 (-0.32, -0.13)
- Excluded data from July 2019 as a wash-out period: -0.23 (-0.33, -0.14)

We also constructed an alternative control group comprised of the 9 states that restricted the maximum period between writing and dispensing of prescriptions for Schedule II, III, or IV drugs to 30 days or less throughout the study period. Using the same model specification as in the primary analysis, the difference-in-differences estimate was -0.34 (-0.38, -0.29).

© 2022 Chua KP et al. JAMA Network Open.