**Appendix S1:** Comparison of the content of the PDMP use mandates, implementation, and concurrent policies affecting prescription of opioid between Kentucky and New York

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State | Mandating providers querying PDMP  (“PDMP use mandates”) | | | Mandating provider registering  for the PDMP database before prescribing opioids  (“PDMP registration mandate”) | Implementation  process | Penalties for failure to check | Changes in the number of queries from pre-mandate to post-mandate | Concurrent policies |
| Prior to the initial prescribing or dispensing of any Schedule II – IV controlled substance for pain or other symptoms associated with the same primary medical complaint | Regularly query PDMP thereafter if the substance remains part of the treatment | Immediately query the PDMP if the prescriber receives information that the patient is misusing | Pain clinics law # |
| **Kentucky** | Yes§ | Yes | Yes | Yes | Expanded staff to support PDMP operations, developed user-friendly interfaces, and updated data frequently to increase the utility of PDMP data | Disciplinary sanctions by licensing board | Number of PDMP queries:  Pre-mandate: 802,131 in 2011, ~2.67million in 2012;  Post-mandate: ~4.55 million in 2013, ~5.00 million in 2014, ~5.50 million in 2015 | Yes |
| **New York** | Yes⁋ | Yes | No | No | Streamlined consultation and reporting, connected with other states’ PDMP, educated practitioners on PDMP use to facilitate the mandate implementation± | Fine up to $2,000, up to 1 year in jail, and/or professional misconduct charges that can result in permanent revocation of license | Number of PDMP queries:  Pre-mandate: 11,000/month in the 3.5 years pre-mandate  Post-mandate:  42,300/day in the 6 months post-mandate | No |

Notes:

Content of PDMP mandates in Kentucky and New York were adapted from Exhibit A1 by Haffajee and colleagues (Haffajee RL, Mello MM, Zhang F, Zaslavsky AM, Larochelle MR, Wharam JF. Four states with robust prescription drug monitoring programs reduced opioid dosages. Health Affairs. 2018;37(6):964-974)

§ In Kentucky, PDMP use mandate does not apply when: 1) prescribing or dispensing a controlled substance immediately prior to, during, or within the 14 days following an operative or invasive procedure or a delivery if the prescribing or dispensing is medically related to the procedure or delivery and the medication usage doesn’t extend beyond the 14 days; 2) prescribing or administering a controlled substance necessary to treat a patient in an emergency situation; 3) prescribing a controlled substance: a) for administration in a hospital or long-term care facility if the PDMP is queried within 12 hours of admission; b) as part of the patient’s hospice or end-of-life care; c) for the treatment of pain associated with cancer or with treatment of cancer; d) within 7 days of an initial prescription if the prescribing is done as a substitute for the initial prescribing, cancels any refills, and requires the patient to dispose of any remaining unused medication; e) within 90 days of the initial prescription if the prescribing is done by another licensee in the same practice or in an existing coverage arrangement, if done for the same patient for the same condition.

⁋ In New York, PDMP use mandate does not apply when: 1) prescribing in the emergency department of a general hospital, provided the quantity does not exceed a 5-day supply; 2) prescribing to a patient in hospice care; 3) it is not reasonably possible for the practitioner to query the PDMP, no other person is available to query, and the quantity does not exceed a 5-day supply; 4) compliance would result in a patient’s inability to obtain a prescription in a timely manner, thereby adversely impacting the medical condition of the patient.

± In NY, the PDMP mandate law requires that: 1) the PDMP shall be secure, easily accessible by practitioners and pharmacists, and compatible with the electronic transmission of prescriptions for controlled substances; 2) to the extent practicable, implementation of the electronic transmission of prescriptions for controlled substances shall serve to streamline consultation of PDMP by practitioners and reporting of prescription information by pharmacists; 3) the PDMP shall be interoperable with other similar registries operated by federal or state governments, i.e. be able to be connected with other states’ PDMP; 4) the commissioner shall, in consultation with the commissioner of education, provide guidance to practitioners, pharmacists, and pharmacies regarding the purposes and uses of the PDMP, i.e. educating practitioners on use of PDMP to facilitate the mandate implementation.

# Pain clinics are facilities primarily engaged in the treatment of pain, which includes the use of controlled substances. Pain clinic laws attempt to prevent high-risk prescriptions of controlled substances among these clinics through ownership and operation requirements, such as mandated inspections and prescribing restrictions.

**Appendix S2**: ICD-9-CM diagnosis codes used to derive outcome measures

|  |  |  |
| --- | --- | --- |
| **Outcome** | **Description** | **ICD-9-CM Code** |
| **Opioid Use Disorder** | Opioid type dependence, unspecified | 304.00 |
| Opioid type dependence, continuous | 304.01 |
| Opioid type dependence, episodic | 304.02 |
| Opioid type dependence, in remission | 304.03 |
| Combinations of opioid type drug with any other drug dependence, unspecified | 304.70 |
| Combinations of opioid type drug with any other drug dependence, continuous | 304.71 |
| Combinations of opioid type drug with any other drug dependence, episodic | 304.72 |
| Combinations of opioid type drug with any other drug dependence, in remission | 304.73 |
| Opioid abuse, unspecified | 305.50 |
| Opioid abuse, continuous | 305.51 |
| Opioid abuse, episodic | 305.52 |
| Opioid abuse, in remission | 305.53 |
| **Heroin Overdose** | Poisoning by heroin | 965.01 |
| Accidental heroin poisoning | E850.0 |
| **Prescription Opioid-involved Overdose** | Poisoning by opium (alkaloids) unspecified | 965.00 |
| Poisoning by methadone | 965.02 |
| Poisoning by other opiates and related narcotics (codeine, meperidine, morphine) | 965.09 |
| Accidental methadone poisoning | E850.1 |
| Accidental opiate poisoning or related narcotics (codeine, meperidine, morphine) | E850.2 |

**Appendix S3:** Descriptive characteristics of ED visits and inpatient discharges related to overdose or opioid use disorder

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Kentucky versus North Carolina | | | | | | New York versus New Jersey | | | | | |
|  | Kentucky | | | North Carolina | | | New York | | | New Jersey | | |
| **Numerator of Outcome 1: ED and inpatient discharges for overdoses involving prescription opioids** | | | | | | | | | | | | |
| Total observations over our study period | 2,789 | | | 4,504 | | | 5,239 | | | 2,322 | | |
| Monthly observations (range) | 20 - 78 | | | 57 - 96 | | | 57 - 119 | | | 27 - 53 | | |
|  | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ |
| Race/ethnicity, % |  |  | 0.330 |  |  | 0.075 |  |  | 0.647 |  |  | 0.360 |
| Non-Hispanic white | 94.4 | 92.3 |  | 76.2 | 76.5 |  | 67.7 | 67.0 |  | 69.0 | 65.1 |  |
| Non-Hispanic black | 3.6 | 3.7 |  | 15.5 | 15.6 |  | 12.5 | 11.1 |  | 15.6 | 16.7 |  |
| Hispanic | 0.7 | 2.5 |  | 1.3 | 3.4 |  | 11.4 | 11.5 |  | 10.2 | 9.3 |  |
| Non-Hispanic other | 1.3 | 1.6 |  | 4.5 | 4.0 |  | 8.0 | 10.4 |  | 4.2 | 7.7 |  |
| Unknown race/ethnicity | 0.0 | 0.0 |  | 2.5 | 0.5 |  | 0.4 | 0.0 |  | 1.0 | 1.2 |  |
| Age, % |  |  | 0.817 |  |  | 0.190 |  |  | 0.699 |  |  | 0.016 |
| 15-24 | 21.3 | 19.3 |  | 27.4 | 25.4 |  | 30.5 | 28.8 |  | 26.8 | 25.4 |  |
| 25-34 | 38.1 | 37.1 |  | 34.2 | 32.6 |  | 34.9 | 35.2 |  | 34.9 | 36.4 |  |
| 35-44 | 40.6 | 43.7 |  | 38.4 | 42.0 |  | 34.6 | 36.1 |  | 38.3 | 38.1 |  |
| Type of payer, % |  |  | 0.005 |  |  | 0.049 |  |  | 0.110 |  |  | 0.160 |
| Medicaid | 35.3 | 43.0 |  | 34.9 | 34.8 |  | 42.7 | 49.4 |  | 16.9 | 27.5 |  |
| Private insurance | 19.4 | 18.2 |  | 23.8 | 25.4 |  | 33.3 | 27.5 |  | 40.9 | 35.4 |  |
| Other payer | 21.1 | 16.6 |  | 13.2 | 14.3 |  | 12.4 | 13.1 |  | 12.9 | 18.4 |  |
| Self-paid | 24.2 | 21.4 |  | 27.5 | 25.2 |  | 11.6 | 10.0 |  | 29.3 | 18.7 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Numerator of Outcome 2: ED and inpatient discharges for overdoses involving heroin** | | | | | | | | | | | | |
| Total observations over our study period | 1,661 | | | 1,020 | | | 2,563 | | | 2,219 | | |
| Monthly observations (range) | 2 - 83 | | | 2 - 50 | | | 10 - 87 | | | 7 - 98 | | |
|  | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ |
| Race/ethnicity, % |  |  | 0.817 |  |  | 0.844 |  |  | 0.529 |  |  | 0.183 |
| Non-Hispanic white | 98.2 | 92.1 |  | 94.8 | 93.9 |  | 80.3 | 84.4 |  | 84.9 | 85.5 |  |
| Non-Hispanic black | 0.9 | 2.4 |  | 2.4 | 2.5 |  | 4.0 | 2.3 |  | 6.7 | 5.3 |  |
| Hispanic | 0.0 | 2.6 |  | 2.4 | 1.2 |  | 8.3 | 7.1 |  | 5.4 | 4.0 |  |
| Non-Hispanic other | 0.9 | 3.0 |  | 0.4 | 1.8 |  | 7.1 | 6.3 |  | 2.0 | 4.1 |  |
| Unknown race/ethnicity | 0.0 | 0.0 |  | 0.0 | 0.7 |  | 0.3 | 0.0 |  | 1.1 | 1.2 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Appendix S3 (Continued):** Descriptive characteristics of ED visits and inpatient discharges related to overdose or opioid use disorder | | | | | | | | | | | | |
|  | Kentucky versus North Carolina | | | | | | New York versus New Jersey | | | | | |
| Kentucky | | | North Carolina | | | New York | | | New Jersey | | |
| Age, % |  |  | 0.648 |  |  | 0.049 |  |  | 0.835 |  |  | 0.246 |
| 15-24 | 39.5 | 32.8 |  | 49.6 | 42.7 |  | 48.3 | 43.2 |  | 40.4 | 40.5 |  |
| 25-34 | 40.4 | 45.4 |  | 37.2 | 42.7 |  | 35.6 | 39.5 |  | 40.5 | 43.9 |  |
| 35-44 | 20.2 | 21.9 |  | 13.2 | 14.6 |  | 16.2 | 17.3 |  | 19.1 | 15.6 |  |
| Type of payer, % |  |  | 0.009 |  |  | 0.509 |  |  | 0.061 |  |  | 0.042 |
| Medicaid | 16.2 | 38.5 |  | 17.6 | 26.8 |  | 40.7 | 49.9 |  | 13.6 | 28.2 |  |
| Private insurance | 15.9 | 16.3 |  | 19.2 | 18.2 |  | 29.7 | 24.3 |  | 26.4 | 32.1 |  |
| Other payer | 15.3 | 11.2 |  | 6.8 | 4.7 |  | 6.0 | 6.1 |  | 8.5 | 11.7 |  |
| Self-paid | 52.6 | 33.0 |  | 55.6 | 50.1 |  | 23.6 | 19.7 |  | 51.6 | 28.0 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Numerator of Outcome 3: ED and inpatient discharges related to opioid use disorder** | | | | | | | | | | | | |
| Total observations over our study period | 37,196 | | | 41,287 | | | 90,533 | | | 55,452 | | |
| Monthly observations (range) | 391 - 815 | | | 433 - 991 | | | 1,028 – 1,911 | | | 731 – 1,086 | | |
|  | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ | Pre-  policy | Post-policy | P-value§ |
| Race/ethnicity, % |  |  | <0.001 |  |  | 0.001 |  |  | 0.006 |  |  | 0.005 |
| Non-Hispanic white | 91.2 | 92.4 |  | 87.2 | 86.2 |  | 72.0 | 73.5 |  | 69.9 | 73.4 |  |
| Non-Hispanic black | 2.0 | 2.7 |  | 7.5 | 8.0 |  | 10.3 | 8.6 |  | 19.5 | 15.6 |  |
| Hispanic | 5.6 | 3.5 |  | 0.7 | 1.5 |  | 9.7 | 9.0 |  | 7.3 | 6.9 |  |
| Non-Hispanic other | 1.3 | 1.4 |  | 3.2 | 3.4 |  | 7.7 | 9.0 |  | 2.5 | 3.5 |  |
| Unknown race/ethnicity | 0.0 | 0.0 |  | 1.4 | 0.9 |  | 0.4 | 0.0 |  | 0.9 | 0.7 |  |
| Age, % |  |  | 0.022 |  |  | 0.282 |  |  | <0.001 |  |  | 0.007 |
| 15-24 | 28.8 | 25.8 |  | 25.5 | 24.7 |  | 26.8 | 26.2 |  | 25.8 | 23.7 |  |
| 25-34 | 46.5 | 49.0 |  | 44.9 | 46.6 |  | 43.3 | 46.6 |  | 39.3 | 45.8 |  |
| 35-44 | 24.8 | 25.2 |  | 29.5 | 28.7 |  | 29.9 | 27.2 |  | 35.0 | 30.5 |  |
| Type of payer, % |  |  | <0.001 |  |  | 0.236 |  |  | <0.001 |  |  | <0.001 |
| Medicaid | 44.6 | 49.1 |  | 43.2 | 40.2 |  | 57.0 | 61.4 |  | 23.3 | 40.7 |  |
| Private insurance | 15.5 | 16.0 |  | 16.8 | 19.3 |  | 21.0 | 18.7 |  | 23.6 | 22.7 |  |
| Other payer | 16.9 | 14.2 |  | 13.1 | 13.0 |  | 9.9 | 10.4 |  | 10.8 | 14.8 |  |
| Self-paid | 23.0 | 20.2 |  | 26.5 | 27.3 |  | 12.2 | 9.5 |  | 42.2 | 21.9 |  |

*Note*: ED: emergency department. Authors’ analyses of 2010–2014 Healthcare Cost and Utilization Project State Inpatient Databases and State Emergency Department Databases. § Statistical tests (two sample t-test for continuous variables; χ2 test for binary or categorical variables) conducted to compare the changes in sample characteristics from the first month to the last month of the study period (2010-2014).