**Supplemental digital content**

**Online-only Figure 1 Legend:** This figure shows the cohort selection flow chart for the study and includes the numbers of patients who were excluded at each step and why.

 **Online-only Figure 1. Cohort Selection Flow Chart, 2007-2012**

Total beneficiaries in the Pennsylvania Medicaid Program

N=4,012,313

N=2,908,782

N=372,347

Exclude: 1) Non-Pennsylvania residents (n=159,567)

 2) Dual eligible (n=670,462)

3) Any cancer diagnosis (n=273,502)

Exclude: 1) No opioid use (n=2,182,334)

2) Non-oral,-transdermal, or submucosal opioid (n=147)

3) Baseline ineligibility for each episode and across all episodes a (n=189,078)

4) Buprenorphine use and/or methadone maintenance for opioid use disorder (n=3,737)

Exclude: 1) Age <18 or age >64 years old (n=159,959) b

2) Long-term care ≥90 days (n=1,159)

3) Receiving hospice benefits (n=21)

N=533,486

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a Those meeting any of following conditions were considered ineligible: (1) opioid fill < 6 months before index fill; (2) overdose < 6 months before index fill; (3) opioid use disorder < 6 months before index fill. b Exclusion applies to the year wherein the index opioid index fill occurred.

**Online-only Figure 2 Legend:** This figure provides a visual example of what potential opioid treatment episodes may look like at the patient level. These include patients with a single treatment episode (Patient 1) and patients with varying lengths and numbers of episodes (Patients 2-3).

**Appendix Figure 2. Examples of Patient Episodes a**

= Baseline period = Index opioid fill = Eligible episode b

Patient 1:

Patient 2:

Patient 3:

Patient 4:

**a** Opioid treatment episodes vary in length of time and may end due to a ≥6 month gap in opioid fill or reaching the end of the data. b Varying length of lines represents the varying lengths of individual episodes.

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| **Online-only Table 1. International Classification of Diseases 9th to 10th Edition Crosswalk for Opioid Medication Poisoning and Use Disorders** |
| **ICD-9**  | **Description** | **ICD-10**  | **Description** |
| 965.00 | Poisoning by opium (alkaloids) unspecified | T400X1A | Poisoning by opium, accidental (unintentional), initial encounter |
|  |  | T400X2A | Poisoning by opium, intentional self-harm, initial encounter |
|  |  | T400X3A | Poisoning by opium, assault, initial encounter |
|  |  | T400X4A | Poisoning by opium, undetermined, initial encounter |
| 965.02 | Poisoning by methadone | T403X1A | Poisoning by methadone, accidental (unintentional), initial encounter |
|  |  | T403X2A | Poisoning by methadone, intentional self-harm, initial encounter |
|  |  | T403X3A | Poisoning by methadone, assault, initial encounter |
|  |  | T403X4A | Poisoning by methadone, undetermined, initial encounter |
| 965.09 | Poisoning by other opiates and related narcotics | T402X1A | Poisoning by other opioids, accidental (unintentional), initial encounter |
|  |  | T402X2A | Poisoning by other opioids, intentional self-harm, initial encounter |
|  |  | T402X3A | Poisoning by other opioids, assault, initial encounter |
|  |  | T402X4A | Poisoning by other opioids, undetermined, initial encounter |
|  |  | T404X1A | Poisoning by other synthetic narcotics, accidental (unintentional), initial encounter |
|  |  | T404X2A | Poisoning by other synthetic narcotics, intentional self-harm, initial encounter |
|  |  | T404X3A | Poisoning by other synthetic narcotics, assault, initial encounter |
|  |  | T404X4A | Poisoning by other synthetic narcotics, undetermined, initial encounter |
|  |  | T40601A | Poisoning by unspecified narcotics, accidental (unintentional), initial encounter |
|  |  | T40602A | Poisoning by unspecified narcotics, intentional self-harm, initial encounter |
|  |  | T40603A | Poisoning by unspecified narcotics, assault, initial encounter |
|  |  | T40604A | Poisoning by unspecified narcotics, undetermined, initial encounter |
|  |  | T40691A | Poisoning by other narcotics, accidental (unintentional), initial encounter |
|  |  | T40692A | Poisoning by other narcotics, intentional self-harm, initial encounter |
|  |  | T40693A | Poisoning by other narcotics, assault, initial encounter |
|  |  | T40694A | Poisoning by other narcotics, undetermined, initial encounter |
| E.850.1 | Accidental methadone poisoning  | No Code Results | N/A |
| E.850.2 | Accidental opioid poisoning- not elsewhere classified. | No Code Results | N/A |
| 304.00 | Opioid type dependence unspecified use | F1120 | Opioid dependence, uncomplicated |
| 304.01 | Opioid type dependence continuous use | F1120 | Opioid dependence, uncomplicated |
| 304.02 | Opioid type dependence episodic use | F1120 | Opioid dependence, uncomplicated |
| 304.03 | Opioid type dependence in remission | F1121 | Opioid dependence, in remission |
| 304.70 | Combinations of opioid type drug with any other drug dependence unspecified use | F1920 | Other psychoactive substance dependence, uncomplicated |
| 304.71 | Combinations of opioid type drug with any other drug dependence continuous use | F1920 | Other psychoactive substance dependence, uncomplicated |
| 304.72 | Combinations of opioid type drug with any other drug dependence episodic use | F1920 | Other psychoactive substance dependence, uncomplicated |
| 304.73 | Combinations of opioid type drug with any other drug dependence in remission | F1921 | Other psychoactive substance dependence, in remission |
| 305.50 | Nondependent opioid abuse unspecified use | F1110 | Opioid abuse, uncomplicated |
| 305.51 | Nondependent opioid abuse continuous use | F1110 | Opioid abuse, uncomplicated |
| 305.52 | Nondependent opioid abuse episodic use | F1110 | Opioid abuse, uncomplicated |
| 305.53 | Nondependent opioid abuse in remission | F1110 | Opioid abuse, uncomplicated |

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| **Online-only Table 2. Covariates Based on International Classification of Disease, 9th edition** |
| Alcohol dependence | 303, 303.0, 303.00, 303.01, 303.02, 303.03, 303.9, 303.90, 303.91, 303.92, 303.93 |
| Alcohol abuse: | 305.0, 305.00, 305.01, 305.02, 305.03 |
| Drug dependence (other than opioids) | 304.1, 304.10, 304.11, 304.12, 304.13, 304.2, 304.20, 304.21, 304.22, 304.23, 304.3, 3043.0, 304.31, 304.32, 304.33, 304.4, 304.40, 304.41, 304.42, 304.43, 304.5, 304.50, 304.51, 304.52, 304.53, 304.6, 304.60, 304.61, 304.62, 304.63, 304.8, 304.80, 304.81, 304.82, 304.83, 304.70, 304.9, 304.90, 304.91, 304.92, 304.93 |
| Drug abuse (other than opioids) | 305.2, 305.20, 305.21, 305.22, 305.23, 305.3, 305.30, 305.31, 305.32, 305.33, 305.4, 305.40, 305.41, 305.42, 305.43, 305.6, 305.60, 305.61, 305.62, 305.63, 305.7, 305.70, 305.71, 305.72, 305.73, 305.8, 305.80, 305.81, 305.82, 305.83, 305.9, 305.90, 305.91, 305.92, 305.93 |
| Adjustment disorders | 309.0, 309.1, 309.22, 309.23, 309.24, 309.28, 309.29, 309.3, 309.4, 309.82, 309.83, 309.89, 309.9 |
| Anxiety disorders | 293.84, 300.00, 300.01, 300.02, 300.09, 300.10, 300.20, 300.21, 300.22, 300.23, 300.29, 300.3, 300.5, 300.89, 300.9, 308.0, 308.1, 308.2, 308.3, 308.4, 308.9, 309.81, 313.0, 313.1, 313.21, 313.22, 313.3, 313.82, 313.83 |
| Mood disorders | 293.83, 296.00, 296.01, 296.02, 296.03, 296.04, 296.05, 296.06, 296.10, 296.11, 296.12, 296.13, 296.14, 296.15, 296.16, 296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 296.40, 296.41, 296.42 296.43, 296.44, 296.45, 296.46, 296.50, 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.7, 296.80, 296.81, 296.82, 296.89, 296.90, 296.99, 300.4, 311 |
| Personality disorders | 301.0, 301.10, 301.11, 301.12, 301.13, 301.20, 301.21, 301.22, 301.3, 301.4, 301.50, 301.51, 3015.9, 301.6, 301.7, 301.81, 301.82, 301.83, 301.84, 301.89, 301.9 |
| Miscellaneous mental health disorders | 293.89, 293.9, 300.11, 300.12, 300.13, 300.14, 300.15, 300.16, 300.19, 300.6, 300.7, 300.81, 300.82, 302.1, 302.2, 302.3, 302.4, 302.50, 302.51, 302.52, 302.53, 302.6, 302.70, 302.71, 302.72, 302.73, 302.74, 302.75, 302.76, 302.79, 302.81, 302.82, 302.83, 302.84, 302.85, 302.89, 302.9, 306.0, 306.1, 306.2, 306.3, 306.4, 306.50, 306.51, 306.52, 306.53, 306.59, 306.6, 306.7, 306.8, 306.9, 307.1, 307.40, 307.41, 307.42, 307.43, 307.44, 307.45, 307.46, 307.47, 307.48, 307.49, 307.50, 307.51, 307.52, 307.53, 307.54, 307.59, 307.80, 307.81, 307.89, 310.1, 316, 648.40, 648.41, 648.42, 648.43, 648.44, V40.2, V40.3, V40.31, V40.39, V40.9, V67.3 |
| Back pain | 721.3, 721.4, 721.41, 721.42, 721.5, 721.6, 721.7, 721.8, 721.9, 721.90, 721.91, 722.2, 722.30, 722.70, 722.80, 722.90, 722.32, 722.72, 722.82, 722.92, 722.39, 722.73, 722.83, 722.93, 724.0, 724.00, 724.01, 724.02, 724.03, 724.09, 724.1, 724.2, 724.3, 724.4, 724.5, 724.6, 724.7, 724.70, 724.71, 724.79, 724.8, 724.9, 737.1, 737.3, 738.4, 738.5, 756.10, 756.11, 756.12, 756.13, 756.19, 805.4, 805.8, 839.2, 839.42, 846, 846.0, 847.1, 847.3, 847.2, 847.9 |
| Neck pain | 721.0, 721.1, 722.0, 722.31, 722.71, 722.81, 722.91, 723.0, 723.1, 723.2, 723.3, 723.4, 723.5, 723.6, 723.7, 723.8, 723.9, 839.0, 839.1, 847.0 |
| Arthritis/joint pain | 710-710.9, 725, 726-726.91, 727-727.9, 728-728.9, 729-729.99, 730-730.99, 731-731.8, 732-732.9, 733-733.9, 734, 735-735.9, 736-736.9, 737-737.9, 738-738.9, 739-739.9 |
| Headache/ migraine pain | 346-346.93, 307.81 |
| HIV/AIDS | 042, 079.53, 279.10, 279.19, 795.71, 795.8, 795.81, 795.82, 795.83 |

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| **Online-only Table 3. Patient Characteristics/ Episode Characteristics 2007-2012a**  |
| Indicator |  N |  % |
| Alcohol abuse/dependence  | 19,291 | 3.3 |
| Drug abuse/dependence | 29,306 | 5.0 |
| Adjustment disorders | 12,241 | 2.1 |
| Anxiety disorders | 50,611 | 8.7 |
| Mood disorders | 115,214 | 19.8 |
| Personality disorders | 3,005 | 0.5 |
| Miscellaneous mental health disorders | 19,255 | 3.3 |
| Back pain | 78,222 | 13.4 |
| Neck pain | 27,023 | 4.6 |
| Arthritis/joint pain | 92,892 | 15.9 |
| Headache/migraine pain | 19,019 | 3.3 |
| HIV/AIDS | 5,010 | 0.9 |
| Emergency department visit | 269,137 | 46.2 |
| Elixhauser comorbidity index ᵇ | 0.9 | 1.5 |
| Methadone maintenance | 3,494 | 0.6 |
| Buprenorphine for opioid use disorder | 5,801 | 1.0 |
| Any benzodiazepine use | 64,585 | 11.1 |
| Any muscle relaxant use | 37,228 | 6.4 |
| Number of eligible episodes  | 1.6 | 0.9 |
| Length of follow up, days | 488.5 | 388.8 |
| ª Among all eligible episodes (N=583,013); b Mean, standard deviation. |