

## Supplementary Online Content

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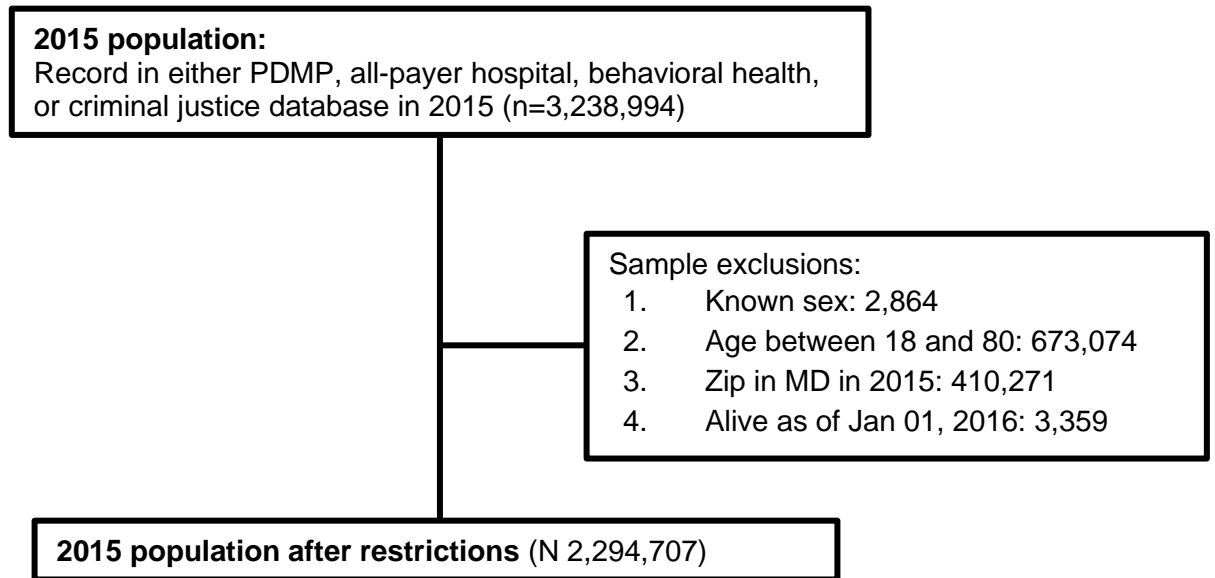
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This supplementary material has been provided by the authors to give readers additional information about their work.

**eFigure 1. Sample Construction Diagram**



## **eMethods. Data Linking Algorithm**

The MPI uses a powerful probabilistic matching algorithm specifically configured for Maryland that reduces the risk of false positive correlations (linking patient identities that actually represent different people) to a near-zero level while ensuring limited false negative correlations (not linking patient identities that should be linked). The algorithm analyzes demographic data elements, including name, date of birth, sex, address, phone number, and social security number and assigns a weighted score to determine the degree to which the records within the disparate datasets match. The records are stamped with a unique identification number based on the algorithm's score ("CRISP ID"). This provides a new way to link disparate datasets together in the absence of a unique identifier common across sources. The algorithm used for this study was tuned to link identities according to the configuration used operationally by the State-designed Maryland HIE, CRISP (Chesapeake Regional Information Systems for Our Patients).

The production-level threshold and algorithm for matching was used when processing the datasets. The algorithm was designed to reduce the risk of false positives (linking patient identities that actually represent different people) to a near-zero level while ensuring limited false negatives (not linking patient identities that should be linked) by using conservative scoring methodologies and thresholds.

The probabilistic matching algorithm can be broken into five basic functions:

**Data Input:** The MPI algorithm uses demographic data elements normalized into different "attributes". The algorithm attributes used to link individuals included name, date of birth, gender, address, phone number, and social security number. Each unique attribute was used to create a match score to represent the degree of certainty for an exact match.

**Standardization:** Standardization represents the conversion of the data into its simplest form to allow for easy comparison. The standardization steps used included removing false or anonymous values, such as phone numbers entered as (000) 000-0000, removing any special characters and applying truncations, such as (123) 456-7890 to 4567890, and converting the name to all upper case (Default algorithm for InfoSphere MDM probabilistic matching engine.2015). Two types of address standardization arguments were employed: 1) postal codes patterning, and 2) type of words or characters used for unit information (floor, suite, unit, etc.).(Default algorithm for InfoSphere MDM probabilistic matching engine.2015)

**Bucketing:** Bucketing organizes common data values together using single or multiple attributes to create unique combinations that are more easily recalled during searching and matching. Theoretically, each identity needs to be compared with every previously processed identity, which would be far too consuming without a mechanism to limit it only logical comparisons. The bucketing processes employed by the MPI used in this study included Name (First Name + Last Name), Name Phonetic + DOB, Name Phonetic + Zip Code, SSN, Phone, Zip Code, MRN, plus some special attributes specific to Maryland stakeholders.

**Comparison:** The individuals sharing buckets together are then compared and scored using predefined probabilistically generated weights. Each comparison function for the different attributes generates a score that can be positive or negative. Full points were awarded for exact matches and partial points were given for common but minor data discrepancies, such as the use of nicknames, misspellings, and transposed dates, names, and numbers. The comparison function incorporates various approaches to processing information that inherently have data quality challenges:

- Initials and full word comparison: matches on initials or full word are assessed and scored.
- Enhanced soundex: words with similar phonetic sounds receive a higher score
- Frequency indexing: common words and names yield lower scores; uncommon words and names yield higher scores.
- Nickname tables: tables that equate formal and informal names and cross-compare the exact and phonetic names.
- Edit distance calculations: the number of changes needed for two values to be equivalent, the lower the number of changes the more likely the records are a match. Prefix and compound comparisons are also employed where matches may be missed by the edit-distance calculation, for example, Belair and Bel Air would be compared.
- Acronym comparison: for example, D.C. would be compared with District of Columbia.
- Attribute weights: for example, phone number receives a higher weight than gender.
- Historical values in matching: the use of previous addresses or names (maiden names) as part of the matching technology improves the matching capability.
- False positive filter: applies deterministic logic to specific false positive matches and uses the result to apply a penalty score.

Score: The final score is a sum of scores from the comparison functions in the algorithm and reflects the degree of match certainty between the two individuals being compared. The patient was a “match” if above the CRISP-defined threshold (score  $\geq 13.1$ ), “potential match” if the individuals are close but not strong enough to be linked together (score between 13.1 and 10.2), or “not matched” (score  $\geq 10.1$ ). The attributes configured for comparison and MPI weight distributions include:

Attribute	Max Weight	Min Weight
<b>Name/ Previous Name (1 attribute)</b>	4.08 (max 7.00)	Invalid Names: -2.35; Other: -1.45
<b>Date of Birth (1 attribute)</b>	4.75	-3.92
<b>Gender (1 attribute)</b>	M: 0.23; F: 0.38; Other: 0.23	-2.03
<b>SSN – Full (1 attribute)</b>	3.66	-5.37
<b>SSN - Last four (1 attribute)</b>	1.85	-1
<b>Patient Address and Phone Combinations (2 attributes)</b>		
Patient Address - Missing & Phone - Missing	0	N/A
Patient Address - Match & Phone - Missing	5.01	N/A
Patient Address - Missing & Phone - Match	4.79	N/A
Patient Address - Match & Phone - Match	5.24	N/A
Patient Address - Non-Match & Phone - Missing	4.03	-2.83
Patient Address - Missing & Phone - Non-Match	4.75	-3.61
Patient Address - Non-Match & Phone - Non-Match	4.95	-2.19
<b>False Positive filter (4 attributes)</b>		
Name: matching, Gender: missing, DOB: apart by more than 15 years, SSN: missing		-3
Name: matching, Gender: missing, DOB: apart by more than 15 years, SSN: not missing		-5
Name: partial matching, Gender: missing, DOB: apart by more than 15 years, SSN: missing		-3
Name: partial matching, Gender: missing, DOB: apart by more than 15 years, SSN: not missing		-5
Name: not matching, Gender: missing, DOB: matching		-5
Name: not matching, Gender: missing, DOB: apart by more than 15 years		-5
Name: matching, Gender: matching, DOB: apart by more than 15 years, SSN: missing		-3
Name: matching, Gender: matching, DOB: apart by more than 15 years, SSN: not missing		-5
Name: partial matching, Gender: matching, DOB: matching, SSN: missing		-2
Name: partial matching, Gender: matching, DOB: matching, SSN: matching		-2
Name: partial matching, Gender: matching, DOB: matching, SSN: edit distance	-2.5	-5
Name: partial matching, Gender: matching, DOB: apart by more than 15 years, SSN: missing		-3
Name: partial matching, Gender: matching, DOB: apart by more than 15 years, SSN: not missing		-5
Name: not matching, Gender: matching, DOB: matching, SSN: missing		-4
Name: not matching, Gender: matching, DOB: matching, SSN: matching		-3.5
Name: not matching, Gender: matching, DOB: matching, SSN: edit distance	-4	-5
Name: not matching, Gender: matching, DOB: apart by more than 15 years		-5
Name: matching, Gender: not matching, DOB: apart by more than 15 years, SSN: missing		-3
Name: matching, Gender: not matching, DOB: apart by more than 15 years, SSN: not missing		-5
Name: partial matching, Gender: not matching, DOB: matching, SSN: missing or not matching		-2.5
Name: partial matching, Gender: not matching, DOB: apart by more than 15 years, SSN: missing		-3
Name: partial matching, Gender: not matching, DOB: apart by more than 15 years, SSN: not missing		-5
Name: not matching, Gender: not matching, DOB: matching		-5
Name: not matching, Gender: not matching, DOB: apart by more than 15 years		-5

An example scoring of two individual's test demographics processed through the operational MPI's probabilistic algorithm is represented below:

Comparison	Grape, Gilbert, PDMP:9900991	Gilbert, Grape, DPSCS: 55324343	Weight
XNM	GRAPE GILBERT	GILBERT GRAPE	6.84
Date of Birth	19840101	19840101	4.75
Gender	F	F	0.23
Address	4145 EARL C ADKINS DR RIVER WV 26000	4145 EARL C ADKINS DR RIVER WV 26000	5.01
Phone	301-222-2999		
SSN	X16326289	X214024632	-2.66
False Positive Filter	19840101	19840101	0
<b>Total Match Score</b>			<b>14.17</b>

**eTable 1. Study Data Sources**

Database	Description
Maryland PDMP	The Maryland PDMP collects information on controlled substance prescriptions (Schedule II–V) dispensed within the state, including mail-order pharmacies dispensing into Maryland and pharmaceuticals dispensed in physician offices. Any controlled substances administered with assistance, such as inpatient hospital, assisted living, or hospice, are exempt from reporting to the PDMP. Additionally, opioid treatment programs (e.g., methadone maintenance) are exempt from reporting to the PDMP owing to the complexities of the 42 CFR Part 2 federal statute governing confidentiality of substance use disorder patient records.
Hospital Services Cost Review Commission	An administrative claims database of all Maryland acute care and licensed specialty hospital records that are reported to the Maryland Health Services Cost Review Commission. This is an all-payer database that includes hospital inpatient, outpatient, and emergency departments.
Beacon Health Options	Records from the Administrative Services Organization that manages all public behavioral health services in specialty settings in the state of Maryland paid for by either Medicaid or State dollars (excludes private physician offices/clinics)
Department of Public Safety and Corrections	This database includes state prisons, arrests from all jurisdictions, and parole and probation agencies across the state. The sample was defined as all adults aged 18+ years who had a record for either an arrest, an incarceration post-conviction (excludes pretrial detainees), or a parole or probation case. Records were limited to those linked specifically to drug or property crimes. Individuals in the study sample could have multiple records or charges per incident and fall into one or more criminal justice subgroups (incarcerated, arrested, or parole/probation).
Office of Chief Medical Examiner	the Office of Chief Medical Examiner, a statewide agency that investigates all deaths in which a physician was not in attendance or was due to a homicide, suicide, injury, or unusual circumstances

**eTable 2. Specific Study Variables**

<b>Variable</b>	<b>Definition/Variable Construction</b>
<b><i>Demographics in 2015</i></b>	
Male	Sex was defined by using the most recent record on which it was present with a hierarchical logic. First using the PDMP, if not present in the PDMP the HSCRC, the Beacon, and finally DPSCS
Age (in categories)	Age was defined by using the most recent record on which it was present with a hierarchical logic. First using the PDMP, if not present in the PDMP the HSCRC, the Beacon, and finally DPSCS
<b><i>Prescription Drug Monitoring Program in 2015</i></b>	
Any long-acting opioid prescription	Long-acting opioids included methadone, fentanyl patch, and long-acting oxycodone (OxyContin) and were defined using a list of NDC codes (see NDC table)
short-acting opioids( in categories)	Short-acting opioids included morphine, hydromorphone, and hydrocodone and were defined using a list of NDC codes
Any buprenorphine prescription for OUD	Buprenorphine prescriptions included all formulations except for Butrans and Buccal strips and were defined using a list of NDC codes
Any benzodiazepine prescription	Any benzodiazepine included were defined using NDC codes
Number of unique opioid prescribers	A unique opioid prescriber was a prescriber ID associated with writing a prescription or directly dispensing to a patient. We summed the number of unique opioid prescribers for each patient to derive the count.
Annual quantity of opioids in MME	We used the morphine milligram equivalent scale provided by the Centers for Disease Control and assigned an MME to each prescription dispensed to a patient in the calendar year. We then summed the MMEs across all prescriptions.
<b><i>All-payer hospital data in 2015</i></b>	
Emergency room visit (in categories)	Emergency room care was defined using place of service codes. Unique ER visits defined using admissions-level identifier.
Any inpatient admission	place of service codes XX
Any opioid use disorder visit	<u>ICD9</u> : 30400-30403, 30470-30473, 30550-30553 <u>ICD10</u> : F11*
Any other substance use disorder visit	<u>ICD9</u> : 3041*-3045*, 30468, 3048*, 3049*, 3050*, 3052*, 3053*, 3054*, 3056*, 3059* <u>ICD10</u> : F10*, F12*-F16*, F18*F19*
Any nonfatal overdose	See overdose table below
Any non-overdose injury	<u>ICD9</u> : 800-959, 990-999, <u>ICD10</u> : S00-S99, T07-T34, T66-T76, T79

<b><i>Criminal justice data in 2015</i></b>	
Any arrest	At least one record in the arrest file with an arrest date in 2015
Released from prison	At least one record in the prison file with a release date in 2015
Any community supervision	At least one record in the parole/probation file with a case start date in 2015
Any drug misdemeanor only	Having an arrest record in 2015 where highest level of drug-related offense was a misdemeanor
Any drug felony	Having an arrest record in 2015 where highest level of drug-related offense was a felony
<b><i>Behavioral health services in 2015</i></b>	
Any mental health services	An episode of care utilizing psychiatric services in the public behavioral health care system
Any non-OD substance use disorder treatment	An episode of care utilizing substance use disorder services in the public behavioral health care system for a primary substance use disorder other than opioid use disorder
Any OUD treatment with/without medication	An episode of care utilizing substance use disorder services in the public behavioral health care system for opioid use disorder in a setting that delivers medications (methadone, buprenorphine, or naltrexone) or a setting that does not deliver medications.
<b><i>Prospective Outcomes in 2016</i></b>	
nonfatal opioid overdose	ICD9: 96500, 96501, 96502, 96509, E8500, E8501, E8502 ICD10: T400*, T401*, T402*, T403*, T404
Fatal opioid overdose	A record in the Office of the Chief Medical Examiner in which the death was determined to be drug poisoning and the toxicology indicated the presence of any opioids



**eTable 3. Drugs in Each Major Category**

Description	Definition
Buprenorphine	drug_name IN ( 'BUPRENORPHINE-NALOXONE' , 'BUPRENORPHINE HCL' , 'SUBOXONE' , 'ZUBSOLV' , 'BUTRANS' , 'BELBUCA' , 'BUPRENEX' , 'BUNAVAIL' , 'PROBUPHINE' , 'SUBUTEX')
Opioid pain reliever	thera_class IN ('OPIATE AGONISTS', 'OPIATE PARTIAL AGONISTS') and drug_name not in ( 'BUPRENORPHINE-NALOXONE' , 'BUPRENORPHINE HCL' , 'SUBOXONE' , 'ZUBSOLV' , 'BUTRANS' , 'BELBUCA' , 'BUPRENEX' , 'BUNAVAIL' , 'PROBUPHINE' , 'SUBUTEX')
benzodiazaphine	thera_class IN ( 'BENZODIAZEPINES (ANTICONVULSANTS)' , 'BENZODIAZEPINES (ANXIOLYTIC, SEDATIV/HYP)') and drug_name not in ( 'BUPRENORPHINE-NALOXONE' , 'BUPRENORPHINE HCL' , 'SUBOXONE' , 'ZUBSOLV' , 'BUTRANS' , 'BELBUCA' , 'BUPRENEX' , 'BUNAVAIL' , 'PROBUPHINE' , 'SUBUTEX')

**eTable 4. Overdose Table Detailed Codes**

Non-fatal alcohol overdose	<p><u>ICD9:</u> 98000, 98010, 98020, 98030, 98080, 98090, E8600-E8604, E8608, E8609</p> <p><u>ICD10:</u> T510X1*, T510X4*, T511X1*, T511X4*, T512X1*, T512X4*, T513X1*, T513X4*, T518X1*, T518X4*, T520X1*, T520X4*, T521X1*, T521X4*, T5191*, T5194*</p>
Non-fatal benzodiazepine overdose	<p><u>ICD9:</u> 9694*, E8532</p> <p><u>ICD10:</u> T424*</p>
Non-fatal cocaine overdose	<p><u>ICD9:</u> 97081</p> <p><u>ICD10:</u> T405*</p>
Non-fatal other drug overdose (includes amphetamine, barbiturates, non-opioid analgesics, other drug poisoning)	<p><u>ICD9:</u> 9651*, 9654*-9659*, 9670*, 96972, E8503, E8504- E8509, E851*, 96580, 96590, 96700, 96710, 96720, 96730, 96740, 96750, 96760, 96780, 96790, 96800, 96810, 96820, 96830, 96840, 96850, 96860, 96870, 96890, 96900-96905, 96909,96910, 96920, 96930, 96950, 96960, 96970, 96971, 96972, 96973, 96979, 96980, 96990, 97000, 97089, 97090, 97520, 97540, 97780, 97790, 98100, 98200, E8503, E8504, E8507-E8510, E8520-E8525, E8528-E8531, E8538-E8543, E8548, E8551, E8580, E8586, E8588, E8589, E8620, E8621, E8624, E8629, E9800-E9805</p> <p><u>ICD10:</u> T390*-T394*, T398*, T399*, T423*, T4362*, T407X1*, T407X4*, T408X1*, T408X4*, T40901*, T40904*, T40991*, T40994*, T410X1*, T410X4*, T411X1*, T411X4*, T41201*, T41204*, T41291*, T41294*, T413X1*, T413X4*, T423X1*, T423X4*, T426X1*, T426X4*, T428X1*, T428X4*, T43011*, T43014*, T43021*, T43024*, T431X1*, T431X4*, T43201*, T43204*, T43211*, T43214*, T43221*, T43224*, T43291*, T43294*, T433X1*, *T433X4*, T434X1*, T434X4*, T43501*, T43504*, T43591*, T43594*, T43601*, T43604*, T43611*, T43614*, T43621*, T43624*, T43631*, T43634*,T43691*,T43694*, T438X1*, T438X4*, T481X1*, T481X4*, T483X1*, T483X4*, T507X1*, T507X4*, T508X1*, T508X4*, T50901*, T50904*, T50991*, T50994*, T4141*, T4144*, T4271*, T4274*, T4391*, T4394*</p>

**eTable 5. Odds Ratios Associated with Variables in Models Predicting Future Opioid Overdose Death and Non-Fatal Opioid Overdose Events Excluding All Predictors with <2% Prevalence**

<b>Variable (Grouped by Data Source)</b>	<b>Opioid Overdose Death Odds Ratio (95% CI)</b>	<b>Non-Fatal Overdose Events Odds Ratio (95% CI)</b>
<b>C-statistic</b>	0.797	0.820
<b>Demographics</b>		
Male	2.65 (2.45-2.86)	1.50 (1.43-1.57)
Age 35-49 vs 18 - 34	1.27 (1.45-1.40)	0.73 (0.69-0.78)
Age 50-64 vs 18 – 34	1.44 (1.30-1.59)	0.81 (0.76-0.86)
Age 65-80 vs 18 - 34	1.18 (1.04-1.34)	0.88 (0.82-0.95)
<b>All-payer hospital data</b>		
# of emergency room visit: 1-2 vs 0	1.45 (1.33-1.59)	1.77 (1.67-1.87)
# of emergency room visit: 3+ vs 0	1.67 (1.47-1.90)	2.61 (2.42-2.81)
Any inpatient room visit	1.47 (1.34-1.62)	1.32 (1.24-1.39)
Any other substance use disorder visit	2.90 (2.60-3.24)	1.80 (1.68-1.92)
Any opioid use disorder visit	2.33 (2.04-2.65)	5.24 (4.88-5.64)
Any nonfatal overdose	2.17 (1.80-2.63)	3.99 (3.62-4.39)
Any non-overdose injury	1.31 (1.20-1.43)	1.23 (1.17-1.30)
<b>Prescription Drug Monitoring Program</b>		
Any long-acting opioid prescription	1.22 (1.06-1.40)	1.98 (1.84-2.14)
# of short-acting opioids: 1-3 vs 0	0.68 (0.39-1.18)	0.73 (0.55-0.97)
# of short-acting opioids: 4+ vs 0	1.29 (0.75-2.23)	1.35 (1.02-1.79)
Any benzodiazepine prescription	1.54 (1.41-1.67)	1.27 (1.21-1.34)
# of unique opioid prescribers: 1-2 vs 0	0.63 (0.13-3.11)	1.24 (0.60-2.55)
# of unique opioid prescribers: 3+ vs 0	0.60 (0.12-3.00)	1.20 (0.58-2.50)
Total opioid volume: <i>lower versus none</i>	1.97 (0.38-10.27)	1.03 (0.49-2.19)
Total opioid volume: <i>higher versus none</i>	2.11 (0.41-11.00)	1.33 (0.63-2.81)
<b>Behavioral health services</b>		
Any mental health services	1.95 (1.76-2.17)	2.08 (1.96-3-2.21)

**Notes:** All risk information from 2015. Confidence Intervals (CI) at the 95% level are presented for both measures.

**eTable 6. Odds Ratios Associated with Variables in Models Predicting Future Opioid Overdose Death and Non-Fatal Opioid Overdose Events Excluding Opioid Dosage Variable**

<b>Variable (Grouped by Data Source)</b>	<b>Opioid Overdose Death Odds Ratio (95% CI)</b>	<b>Non-Fatal Overdose Events Odds Ratio (95% CI)</b>
<b>C-statistic</b>	0.811	0.850
<b><i>Demographics</i></b>		
Male	2.55 (2.36-2.76)	1.42 (1.35-1.48)
Age 35-49 vs 18 - 34	1.28 (1.15-1.41)	0.74 (0.70-0.79)
Age 50-64 vs 18 - 34	1.51 (1.37-1.67)	0.90 (0.84-0.95)
Age 65-80 vs 18 - 34	1.25 (1.11-1.42)	1.00 (0.93-1.08)
<b><i>All-payer hospital data</i></b>		
# of emergency room visit: 1-2 vs 0	1.45 (1.33-1.59)	1.75 (1.66-1.85)
# of emergency room visit: 3+ vs 0	1.59 (1.40-1.81)	2.44 (2.27-2.63)
Any inpatient room visit	1.52 (1.38-1.66)	1.40 (1.32-1.48)
Any other substance use disorder visit	2.74 (2.45-3.06)	1.66 (1.54-1.78)
Any opioid use disorder visit	1.60 (1.38-1.85)	2.51 (2.32-2.72)
Any nonfatal overdose	2.08 (1.71-2.51)	3.89 (3.53-4.30)
Any non-overdose injury	1.31 (1.20-1.43)	1.24 (1.18-1.31)
<b><i>Prescription Drug Monitoring Program</i></b>		
Any long-acting opioid prescription	1.30 (1.13-1.50)	2.28 (2.11-2.46)
# of short-acting opioids: 1-3 vs 0	0.75 (0.44-1.28)	0.69 (0.52-0.91)
# of short-acting opioids: 4+ vs 0	1.49 (0.87-2.55)	1.51 (1.14-1.98)
Any buprenorphine prescription for OUD	1.71 (1.45-2.03)	1.93 (1.76-2.12)
Any benzodiazepine prescription	1.54 (1.42-1.48)	1.29 (1.23-1.36)
# of unique opioid prescribers: 1-2 vs 0	1.16 (0.68-1.98)	1.48 (1.13-1.95)
# of unique opioid prescribers: 3+ vs 0	1.14 (0.66-1.98)	1.54 (1.16-2.05)
<b><i>Behavioral health services</i></b>		
Any mental health services	1.61 (1.44-1.79)	1.38 (1.29-1.47)
Any non-OUD substance use disorder treatment	1.62 (1.35-1.93)	1.96 (1.74-2.21)
Any OUD treatment with medication	2.03 (1.71-2.40)	4.16 (3.81-4.54)
Any OUD treatment without medication	1.69 (1.37-2.09)	4.16 (3.74-4.63)
<b><i>Criminal justice data</i></b>		
Any arrest	1.63 (0.90-2.94)	1.50 (1.03-2.19)
Released from prison	3.57 (2.28-5.60)	2.81 (2.03-3.88)

Any parole/probation	1.75 (1.40-2.20)	2.05 (1.81-2.32)
Any drug misdemeanor only	1.24 (0.65-2.37)	1.56 (1.04-2.34)
Any drug felony	1.37 (0.60-3.14)	1.12 (0.65-1.94)

**Notes:** All risk information from 2015. Confidence Intervals (CI) at the 95% level are presented for both measures.

**eTable 7. Odds Ratios Associated with Variables in Models Predicting Future Opioid Overdose Death and Non-Fatal Opioid Overdose Events – Restricting Sample to Only Patients with  $\geq 1$  Opioid Analgesic Paid for by Medicaid (N: 166,213)**

<b>Variable (Grouped by Data Source)</b>	<b>Opioid Overdose Death Odds Ratio (95% CI)</b>	<b>Non-Fatal Overdose Events Odds Ratio (95% CI)</b>
<b>C-statistic</b>	0.845	0.847
<b><i>Demographics</i></b>		
Male	2.14 (1.78-2.58)	1.31 (1.19-1.46)
Age 35-49 vs 18 - 34	1.62 (1.27-2.07)	1.03 (0.90-1.17)
Age 50-64 vs 18 – 34	1.82 (1.42-2.32)	1.17 (1.03-1.33)
Age 65-80 vs 18 - 34	1.02 (0.55-1.88)	1.23 (0.93-1.63)
<b><i>All-payer hospital data</i></b>		
# of emergency room visit: 1-2 vs 0	1.58 (1.22-2.04)	1.65 (1.42-1.93)
# of emergency room visit: 3+ vs 0	1.61 (1.19-2.16)	2.00 (1.69-2.36)
Any inpatient room visit	1.15 (0.93-1.43)	1.34 (1.19-1.51)
Any other substance use disorder visit	2.09 (1.64-2.67)	1.46 (1.27-1.67)
Any opioid use disorder visit	1.61 (1.21-2.14)	2.03 (1.73-2.37)
Any nonfatal overdose	2.43 (1.71-3.44)	3.24 (2.67-3.92)
Any non-overdose injury	1.37 (1.11-1.70)	1.33 (1.18-1.50)
<b><i>Prescription Drug Monitoring Program</i></b>		
Any long-acting opioid prescription	1.21 (0.95-1.54)	1.84 (1.62-2.10)
# of short-acting opioids: 1-3 vs 0	0.29 (0.12-0.72)	0.67 (0.36-1.24)
# of short-acting opioids: 4+ vs 0	0.57 (0.23-1.39)	0.97 (0.53-1.79)
Any buprenorphine prescription for OUD	0.79 (0.51-1.23)	1.27 (1.04-1.55)
Any benzodiazepine prescription	1.44 (1.19-1.75)	1.37 (1.23-1.52)
# of unique opioid prescribers: 1-2 vs 0		
# of unique opioid prescribers: 3+ vs 0	0.93 (0.73-1.20)	1.11 (0.96-1.28)
Total opioid volume: <i>lower versus none</i>	1.79 (0.10-32.04)	1.02 (0.19-5.57)
Total opioid volume: <i>higher versus none</i>	1.81 (0.10-32.14)	1.15 (0.21-6.26)
<b><i>Behavioral health services</i></b>		
Any mental health services	1.56 (1.27-1.92)	1.58 (1.41-1.77)
Any non-OUD substance use disorder treatment	1.54 (1.12-2.12)	1.42 (1.16-1.73)
Any OUD treatment with medication	1.96 (1.45-2.64)	2.49 (2.12-2.93)
Any OUD treatment without medication	1.83 (1.22-2.72)	2.57 (2.10-3.15)
<b><i>Criminal justice data</i></b>		

Any arrest	1.09 (0.22-5.40)	1.60 (0.75-3.45)
Released from prison	1.83 (0.51-6.60)	1.65 (0.77-3.55)
Any parole/probation	0.80 (0.42-1.53)	1.54 (1.17-2.01)
Any drug misdemeanor only	1.26 (0.22-7.07)	1.28 (0.56-2.95)
Any drug felony	1.03 (0.11-9.93)	1.15 (0.40-3.35)

**Notes:** All risk information from 2015. Confidence Intervals (CI) at the 95% level are presented for both measures.

**eTable 8. Odds Ratios Associated with Variables in Models Predicting Polydrug Fatal Overdose (Opioid + At Least One Other Drug)**

<b>Variable (Grouped by Data Source)</b>	<b>Combined Overdose Odds Ratio (95% CI)</b>
<b>C-statistic</b>	0.886
<b><i>Demographics</i></b>	
Male	1.45 (1.27-1.64)
Age 35-49 vs 18 - 34	0.96 (0.81-1.13)
Age 50-64 vs 18 – 34	0.98 (0.83-1.15)
Age 65-80 vs 18 - 34	0.83 (0.66-1.06)
<b><i>All-payer hospital data</i></b>	
# of emergency room visit: 1-2 vs 0	1.65 (1.40-1.94)
# of emergency room visit: 3+ vs 0	2.11 (1.70-2.60)
Any inpatient room visit	1.42 (1.22-1.66)
Any other substance use disorder visit	2.62 (2.17-3.15)
Any opioid use disorder visit	2.59 (2.09-3.21)
Any nonfatal overdose	2.35 (1.86-2.98)
Any non-overdose injury	1.25 (1.07-1.45)
<b><i>Prescription Drug Monitoring Program</i></b>	
Any long-acting opioid prescription	1.66 (1.35-2.04)
# of short-acting opioids: 1-3 vs 0	0.65 (0.29-1.47)
# of short-acting opioids: 4+ vs 0	1.50 (0.67-3.35)
Any buprenorphine prescription for OUD	1.51 (1.20-1.91)
Any benzodiazepine prescription	2.13 (1.86-2.44)
# of unique opioid prescribers: 1-2 vs 0	0.87 (0.05-13.68)
# of unique opioid prescribers: 3+ vs 0	0.66 (0.04-10.52)
Total opioid volume: <i>lower versus none</i>	1.97 (0.12-32.29)
Total opioid volume: <i>higher versus none</i>	2.14 (0.13-34.95)
<b><i>Behavioral health services</i></b>	
Any mental health services	1.85 (1.55-2.19)
Any non-OUD substance use disorder treatment	1.61 (1.20-2.16)
Any OUD treatment with medication	2.62 (2.08-3.31)
Any OUD treatment without medication	2.87 (2.19-3.75)
<b><i>Criminal justice data</i></b>	
Any arrest	0.72 (0.22-2.31)



Released from prison	5.65 (3.16-10.08)
Any parole/probation	1.98 (1.48-2.66)
Any drug misdemeanor only	4.10 (1.23-13.65)
Any drug felony	4.11 (1.02-16.53)

**Notes:** All risk information from 2015. Confidence Intervals (CI) at the 95% level are presented for both measures.