APPRISS HEALTH

Statewide Opioid Assessment: Michigan

Identify, Prevent, and Manage Substance Use Disorders

Informed decision making for early intervention and improved outcomes

March 29, 2018

Michigan Collaborates with Appriss Health with New Tool in the Fight Against the Opioid Crisis

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*The Michigan Department of Licensing and Regulatory Affairs (LARA) is one of the first state government agencies in the nation to utilize this new tool recently developed by Appriss Health in the fight against the opioid crisis; Appriss Health's **Statewide Opioid Assessment**.*

The Methods

- To apply this tool, Michigan provided three years of well-documented cases of unintentional overdose deaths, which Appriss Health linked to five years of prescription records in the state's prescription drug monitoring program (PDMP), the Michigan Automated Prescription System (MAPS). More than 7.5 million patients receiving 103.2 million prescriptions over the five years of PDMP history were linked to 5,261 overdose deaths.

The Value

- Using Appriss Health's Statewide Opioid Assessment, lawmakers and local community leaders can tailor laws, target resources, and design innovative programs to best address the opioid crisis in Michigan. This solution, along with other extensive collaborations underway between Michigan and Appriss Health, demonstrate the aggressive commitment of both entities to impact the opioid crisis in the state.
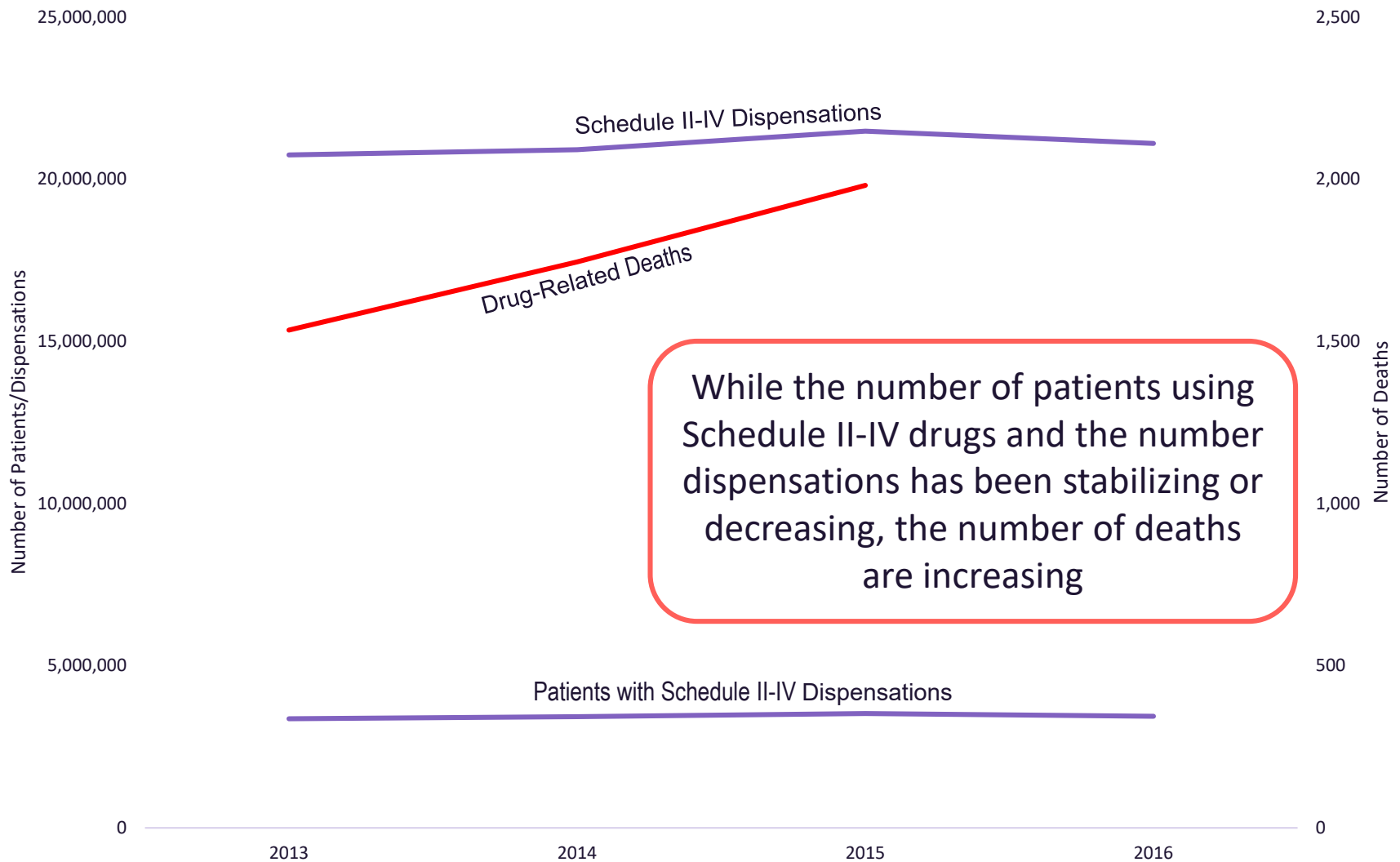
Statewide Opioid Assessment

- Appriss Health's Statewide Opioid Assessment provides state PDMP administrators valuable information on trends and patterns on a state's opioid usage. The Assessment examines patient-level and aggregate trends of controlled-substance prescriptions and overdose deaths within the state. Together, these statistics provide powerful insights into specific prescribing trends and risk factors for overdose death and helps identify communities most affected by the opioid epidemic.

- Michigan was one of the first states in the country to provide all PDMP users in the state access to NarxCare. NarxCare is a substance use disorder prevention and management platform developed by Appriss Health that includes an Overdose Risk Score, which predicts overdose death. The combination of the Statewide Opioid Assessment and the Overdose Risk Score contained in NarxCare both enables state administrators, policy makers, and public health officials to understand trends and over 150,000 providers to quickly assess a patient's PDMP history and risk of overdose death at a glance.

Prescription Drug Crisis in Michigan

Schedule II-IV Dispensations

Drug-Related Deaths

Patients with Schedule II-IV Dispensations

While the number of patients using Schedule II-IV drugs and the number dispensations has been stabilizing or decreasing, the number of deaths are increasing

Source: Michigan PDMP 2013-2016 and Michigan 2013-2015 all state-recorded drug-overdose deaths.

Michigan

PDMP October 23, 2012-October 23, 2017
and
Drug-Related Deaths 2013-2015

General Statistics

Michigan PDMP Data for Prescriptions Written and Medications Dispensed between 2012 and 2017
Drug-Related Deaths between 2013 and 2015

	N	%
Patients	7,575,033	
Patients Who Died (Drug-Related)[1]	5,261	0.09
Patients With History of Receiving an Opioid Narcotic (including MAT)	6,414,174	84.68
Patients With History of Receiving a Sedative	2,849,423	37.62
Patients With History of Receiving Buprenorphine MAT Medication[2]	72,780	0.96
Providers[3]	173,900	
Dispensations	103,214,576	
Dispensations of Opioid Narcotics	53,288,783	51.63
Dispensations of Sedatives	31,028,518	30.06
Prescriptions	84,855,880	
Prescriptions for Opioid Narcotics	47,731,852	56.25
Prescriptions for Sedatives	20,954,308	24.69
National Drug Codes (NDCs)	6,994	
NDCs for Opioid Narcotics	2,646	37.83
NDCs for Sedatives	1,663	23.78

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017 and Michigan 2013-2015 drug-related deaths
Abbreviations: MAT: Medication-Assisted Treatment
Note: DEA number used to identify unique prescribers
[1]Number of deaths are only deaths from 2013-2015 identified by the state of Michigan as drug-related regardless of whether the individual was linked to a PDMP prescription. The denominator is the number of patients with a prescription during 2013-2015 (N=5,903,135).
[2]Buprenorphine Medication Assisted Therapy (MAT) includes all medication dispensations for NDCs falling under specific Generic Code Numbers (GCNs), including off-label use.
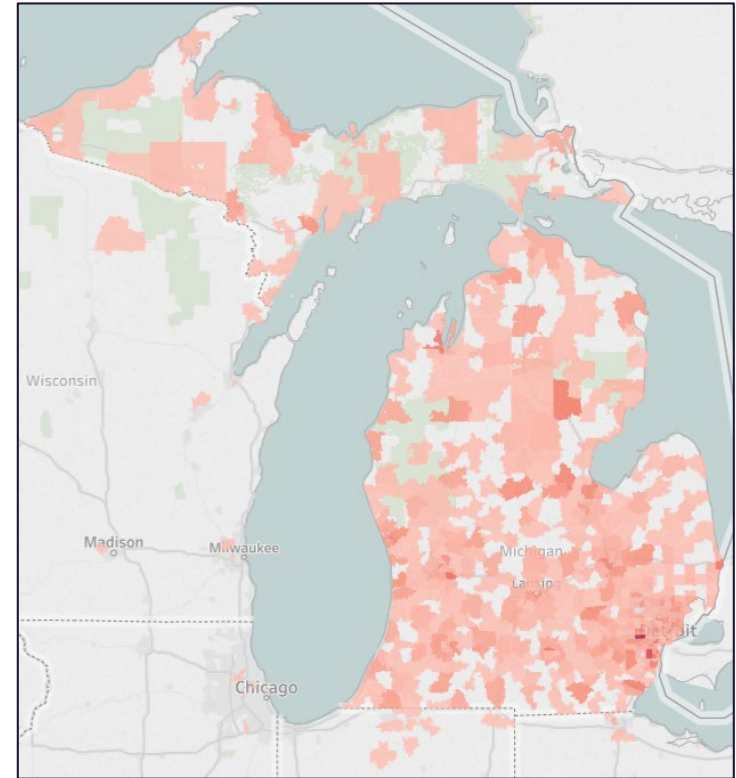[3]Providers may have more than one DEA registration number.

Narcotic and Sedative Prescription Volume by Location

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By Patient Zip Code
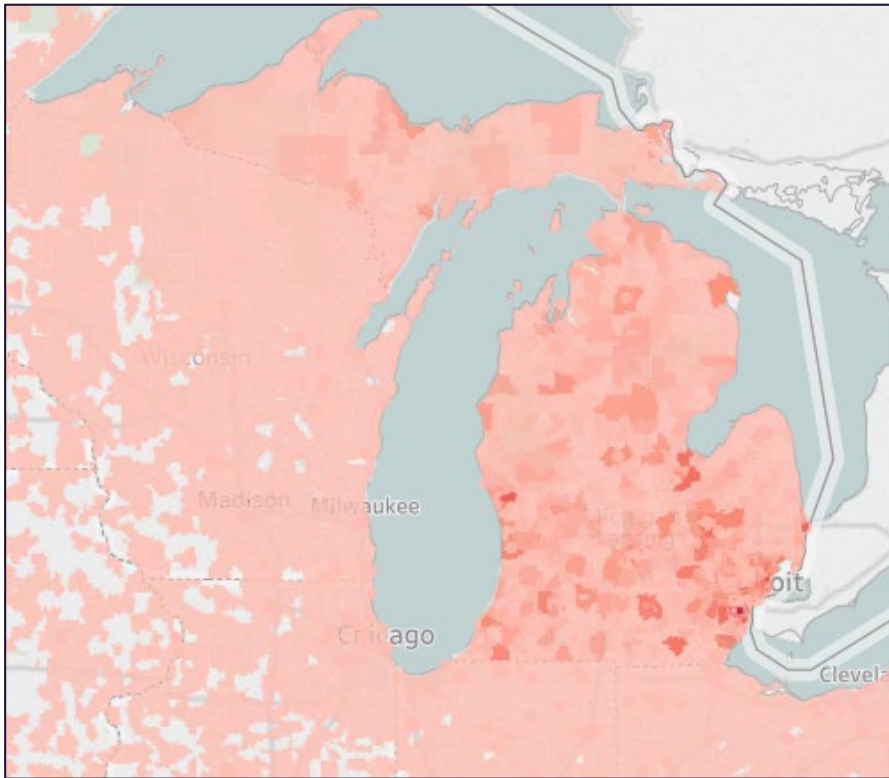
Darker colors represent higher prescription volumes

By Dispenser Zip Code

Only includes dispensers with at least 20 fills

- 96.7% of patients in the PDMP database have Michigan addresses
- 3.3% of patients have addresses in other states
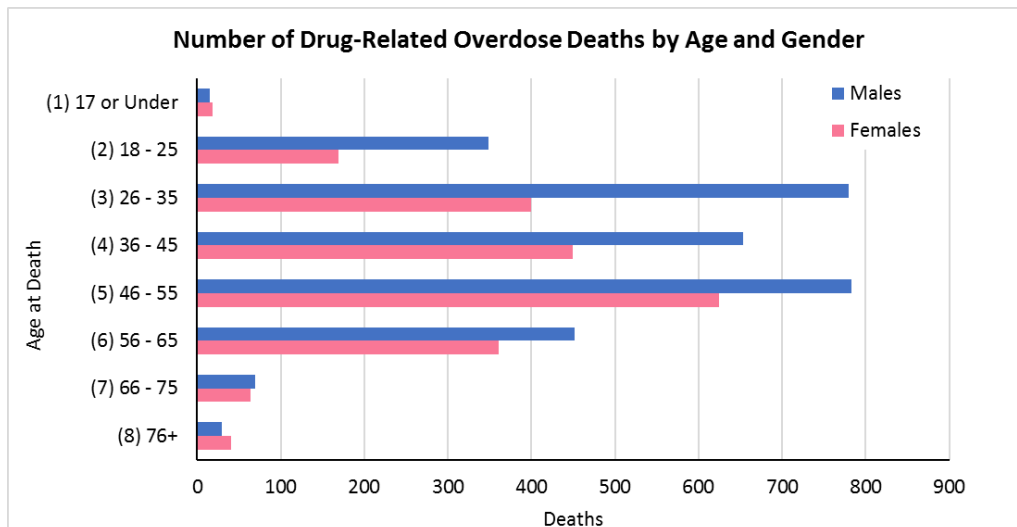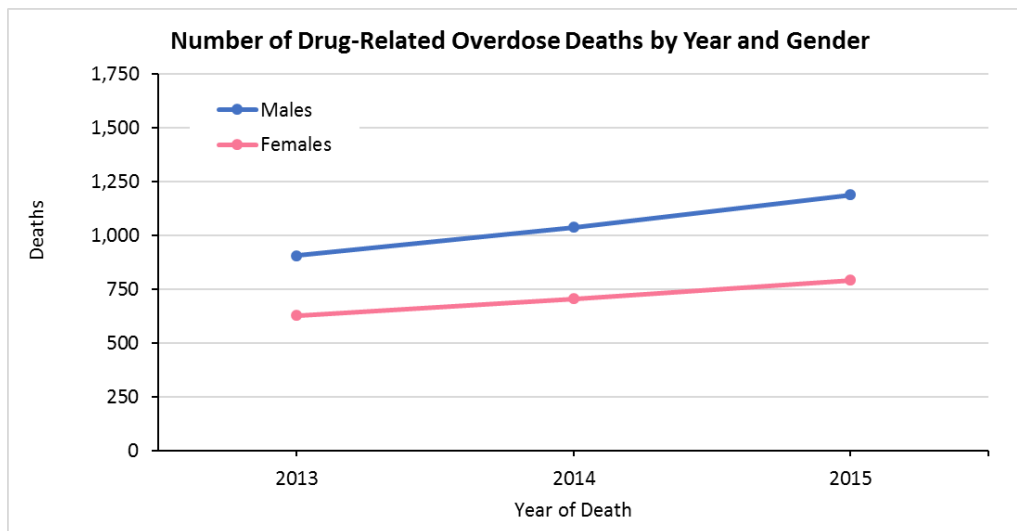- The majority (89.9%) of dispensers are located in Michigan

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017

Patient Characteristics

Death Data

There were 30% more drug-related overdose deaths in 2015 than in 2013

The largest number of drug-related overdose deaths occurred among men aged 26-35 and men aged 46-55

Among women, the largest number of drug-related overdose deaths were in the 46-55 age group

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Number of Drug-Related Overdose Deaths by Year and Gender

Number of Drug-Related Overdose Deaths by Age and Gender

Source: Michigan drug-overdose death data 2013-2015

Death Rates by Location

By City
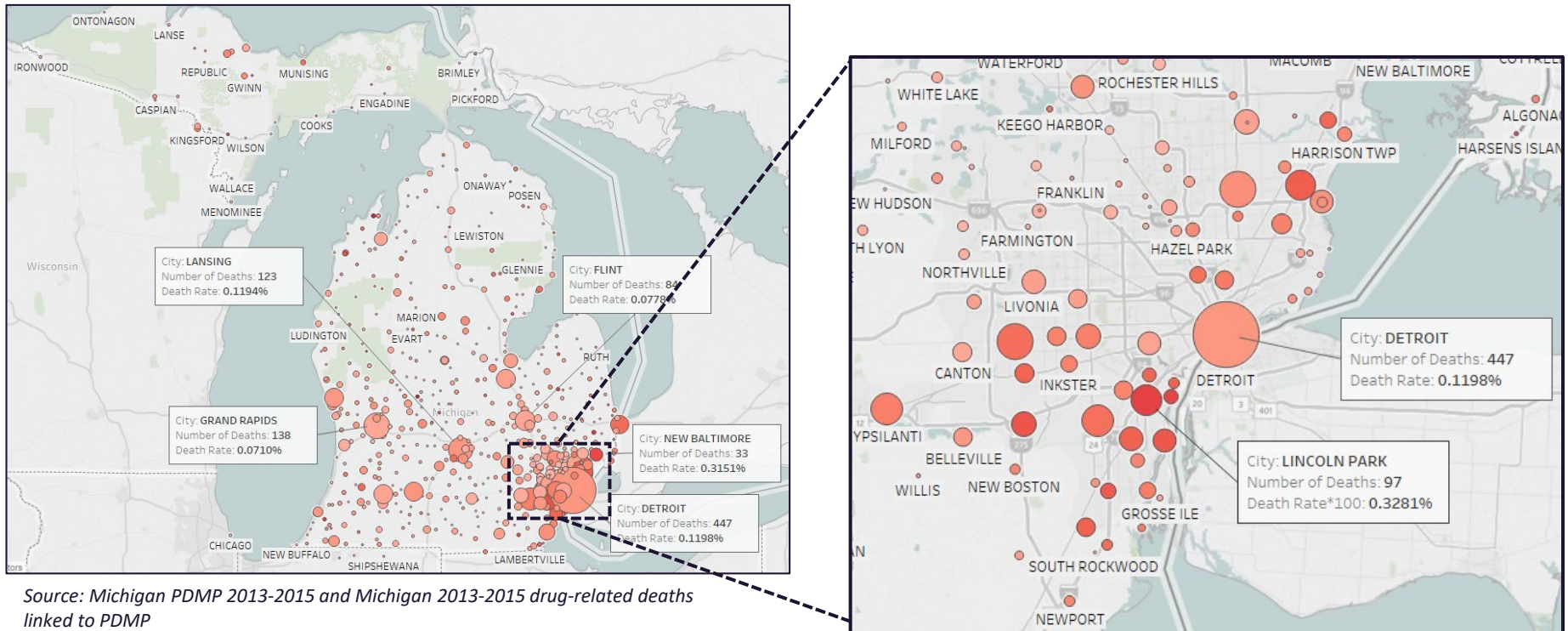
Source: Michigan PDMP 2013-2015 and Michigan 2013-2015 drug-related deaths
linked to PDMP
Darker colors represent higher death rates
Larger bubbles represent more drug-related deaths

- Lincoln Park and Ecorse have the highest drug-related death rates
- Detroit and Grand Rapids have the most drug-related deaths

Top 10 Cities by Drug-Related Overdose Death Rate

City	Deaths per 1,000 Patients	Deaths
LINCOLN PARK	3.281	97
ECORSE	3.168	23
NEW BALTIMORE	3.151	33
ROMULUS	2.828	65
WYANDOTTE	2.770	55
WOODHAVEN	2.679	25
ROSEVILLE	2.603	92
FLAT ROCK	2.523	34
SOUTHGATE	2.519	58
WAYNE	2.456	37
MOUNT CLEMENS	2.365	29

Top 10 Cities by Number of Drug-Related Overdose Deaths

City	Deaths per 1,000 Patients	Deaths
DETROIT	1.198	447
GRAND RAPIDS	0.710	138
WESTLAND	2.206	133
WARREN	1.374	131
LANSING	1.194	123
TAYLOR	2.154	104
YPSILANTI	1.791	103
LINCOLN PARK	3.281	97
ROSEVILLE	2.603	92
FLINT	0.778	84
BATTLE CREEK	1.213	79

Source: Michigan PDMP 2013-2015 and Michigan 2013-2015 drug-related deaths linked to PDMP

Top Cities – 2013

Top 10 Cities by Drug-Related Overdose Death Rate

City	Deaths per 1,000 Patients	Deaths
WYANDOTTE	1.243	14
PORT HURON	1.142	21
ROSEVILLE	1.110	22
LINCOLN PARK	1.086	18
WESTLAND	1.069	35
ROMULUS	0.868	11
TAYLOR	0.705	19
YPSILANTI	0.658	20
DEARBORN HEIGHTS	0.618	12
BAY CITY	0.605	15

Top 10 Cities by Number of Drug-Related Overdose Deaths

City	Deaths per 1,000 Patients	Deaths
DETROIT	0.418	88
WESTLAND	1.069	35
WARREN	0.586	31
LANSING	0.502	29
GRAND RAPIDS	0.233	24
KALAMAZOO	0.418	23
ROSEVILLE	1.110	22
PORT HURON	1.142	21
FLINT	0.337	21
YPSILANTI	0.658	20

Source: Michigan PDMP 2013 and Michigan 2013 drug-related deaths linked to PDMP
Note: Limited to cities with at least 10 deaths in 2013.

Top Cities – 2014

Top 10 Cities by Drug-Related Overdose Death Rate

City	Deaths per 1,000 Patients	Deaths
HAMTRAMCK	1.359	12
ROSEVILLE	1.324	27
SOUTHGATE	1.146	15
ROMULUS	1.087	14
LINCOLN PARK	1.043	18
PORT HURON	0.971	18
TAYLOR	0.790	22
YPSILANTI	0.770	24
WESTLAND	0.767	26
DEARBORN HEIGHTS	0.699	14

Top 10 Cities by Number of Drug-Related Overdose Deaths

City	Deaths per 1,000 Patients	Deaths
DETROIT	0.483	102
WARREN	0.613	33
LANSING	0.516	30
GRAND RAPIDS	0.273	29
ROSEVILLE	1.324	27
WESTLAND	0.767	26
YPSILANTI	0.770	24
SAGINAW	0.479	23
TAYLOR	0.790	22
FLINT	0.327	21

Source: Michigan PDMP 2014 and Michigan 2014 drug-related deaths linked to PDMP
Note: Limited to cities with at least 10 deaths in 2014.

Top Cities – 2015

Top 10 Cities by Drug-Related Overdose Death Rate

City	Deaths per 1,000 Patients	Deaths
LINCOLN PARK	1.938	34
TAYLOR	1.293	37
ROMULUS	1.276	17
ROSEVILLE	1.246	26
WYANDOTTE	1.172	14
EASTPOINTE	1.155	16
WESTLAND	1.140	40
SOUTHGATE	1.100	15
PORT HURON	1.062	20
YPSILANTI	0.808	26

Top 10 Cities by Number of Drug-Related Overdose Deaths

City	Deaths per 1,000 Patients	Deaths
DETROIT	0.650	140
WESTLAND	1.140	40
LANSING	0.653	39
GRAND RAPIDS	0.351	39
TAYLOR	1.293	37
LINCOLN PARK	1.938	34
WARREN	0.554	31
ROSEVILLE	1.246	26
YPSILANTI	0.808	26
BATTLE CREEK	0.645	25

Source: Michigan PDMP 2015 and Michigan 2015 drug-related deaths linked to PDMP
Note: Limited to cities with at least 10 deaths in 2015.

Drug-Related Overdose Death Rate by Average Narcotic MME

Death Rate per 100 Patients

Average MME per Patient: 200 or less, 200 - 400, 400 - 600, 600 - 800, 800 - 1000, 1000 - 1200, 1200 - 1400, 1400 - 1600, 1600 - 1800, 1800 - 2000, 2000+

Drug-Related Overdose Death Rate by Average Sedative LME

Death Rate per 100 Patients

Average LME per Patient: 10 or less, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, 90-100, 100-110, 110-120, 120-130, 130+
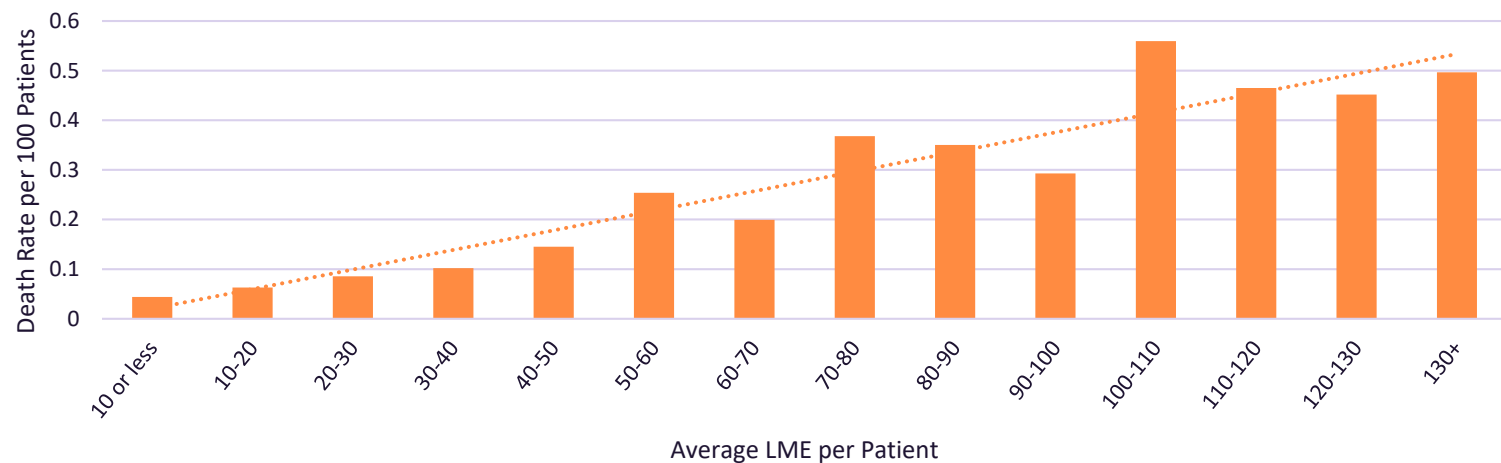
Drug-Related Overdose Death Rates by Patient Behavior

Drug-Related Overdose Death Rate by Number of Prescribers Visited

(Death Rate per 100 Patients vs. Number of Prescribers Visited, 2013-2015)

Drug-Related Overdose Death Rate by Number of Dispensers Visited

(Death Rate per 100 Patients vs. Number of Dispensers Visited, 2013-2015)

1 out of every 100 patients visiting 21+ prescribers or 21+ dispensers between 2013 and 2015 died

Source: Michigan PDMP data (2013-2015) and Michigan drug-related death data (2013-2015) linked to PDMP
Note: DEA number used to identify prescribers and dispensers

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Number of Dispensations by Drug Type

Drug Type	Number of Dispensations (N=103,214,576)		Total Patients[1] (N=7,575,033)		Deaths[2] (N=4,444)		Deaths per 1,000 Patients with a prescription[3]
	n	%	n	%	n	%	
Narcotic[4]	51,117,258	49.53%	6,391,737	84.38%	3366	75.74%	0.52
Buprenorphine MAT	2,171,525	2.10%	72,780	0.96%	380	8.55%	5.82
Sedative	31,028,518	30.06%	2,849,423	37.62%	2924	65.80%	0.97
Stimulant	14,934,746	14.47%	934,717	12.34%	508	11.43%	0.53
Neuropain	1,953,315	1.89%	201,248	2.66%	346	7.79%	1.96
Ginarcotic	373,205	0.36%	116,584	1.54%	64	1.44%	0.52
Steroid	949,011	0.92%	108,737	1.44%	61	1.37%	0.54
Cannabinoid	75,510	0.07%	22,669	0.30%	6	0.14%	0.36
Unassigned	44,431	0.04%	18,216	0.24%	0	0.00%	0.00
Anesthetic	2,006	0.00%	832	0.01%	0	0.00%	0.00
Other	565,074	0.55%	136,163	1.80%	19	0.43%	0.12

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017 and Michigan 2013-2015 drug-related deaths linked to PDMP
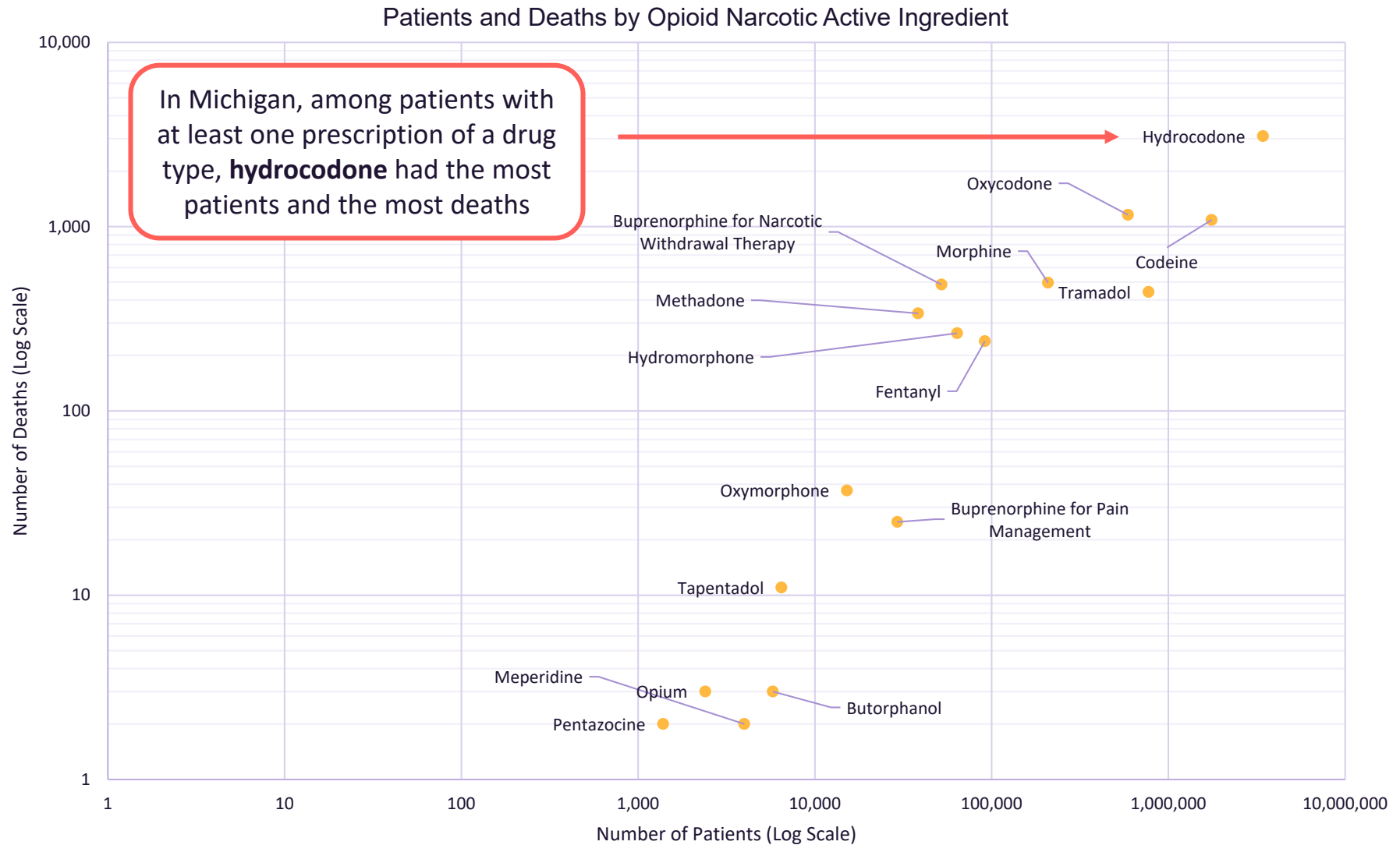*Abbreviations: MAT: Medication-Assisted Treatment*
1. Patients=Total number of patients with at least one prescription for that drug type, Michigan PDMP Oct. 23, 2012-Oct. 23, 2017.
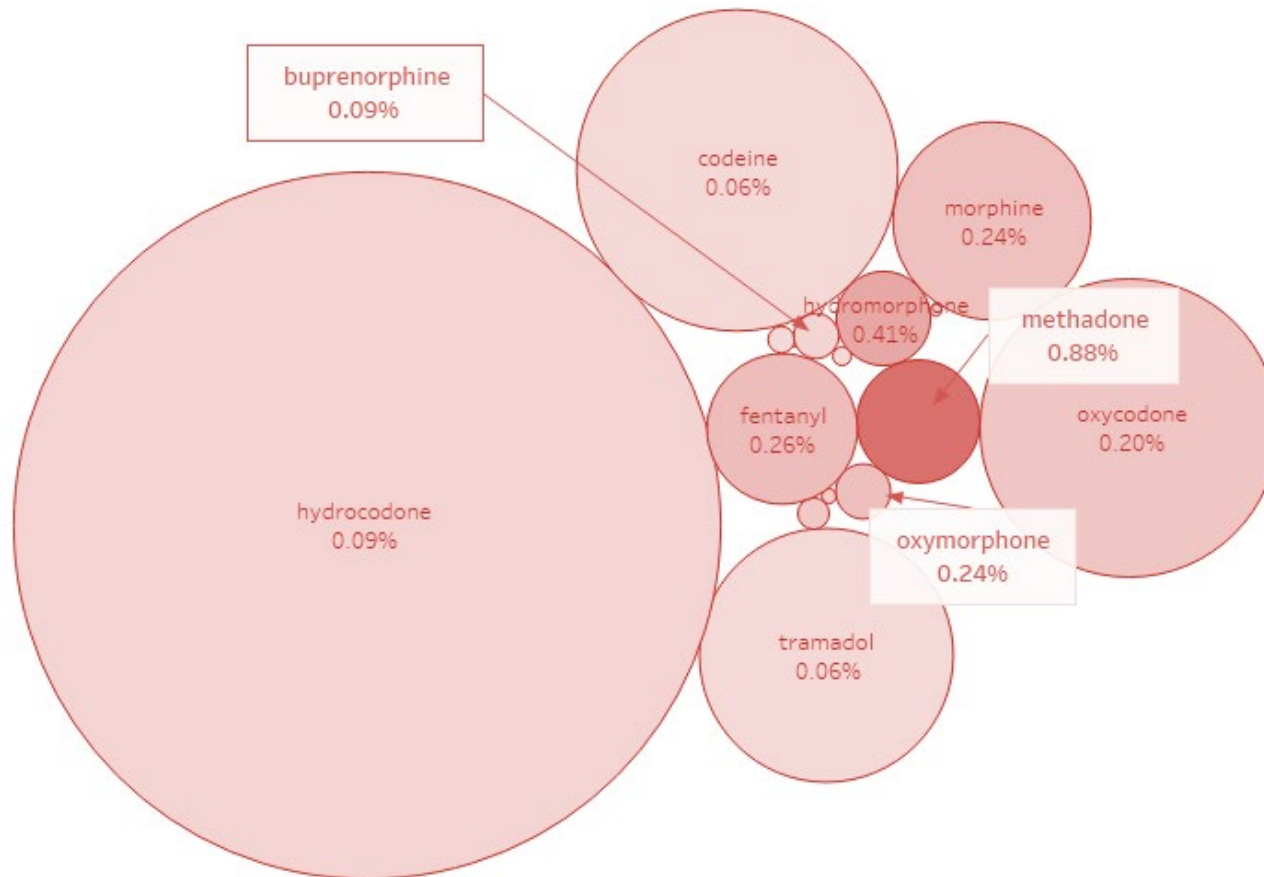*2. Deaths=Number of drug-related overdose deaths that had a prescription of that drug type, 2013-2015 linked to PDMP; patients taking multiple drug types will be counted in each drug type category. 3. Drug-related overdose deaths per 1,000 patients with at least one prescription for that drug type in the year prior to death, 2014-2015 linked to PDMP. Only 2014/2015 deaths were included to ensure a full year of history in the PDMP. 4. Narcotic drug type excludes Buprenorphine MAT prescriptions.*

While the largest proportion of deaths are associated with narcotic (75.7%) and sedative (65.8%) dispensations, the controlled substances with the highest death rates are those for buprenorphine MAT (5.82 deaths per 1,000 patients),
neuropain (1.96 deaths per 1,000 patients), and sedatives (0.97 death per 1,000 patients).

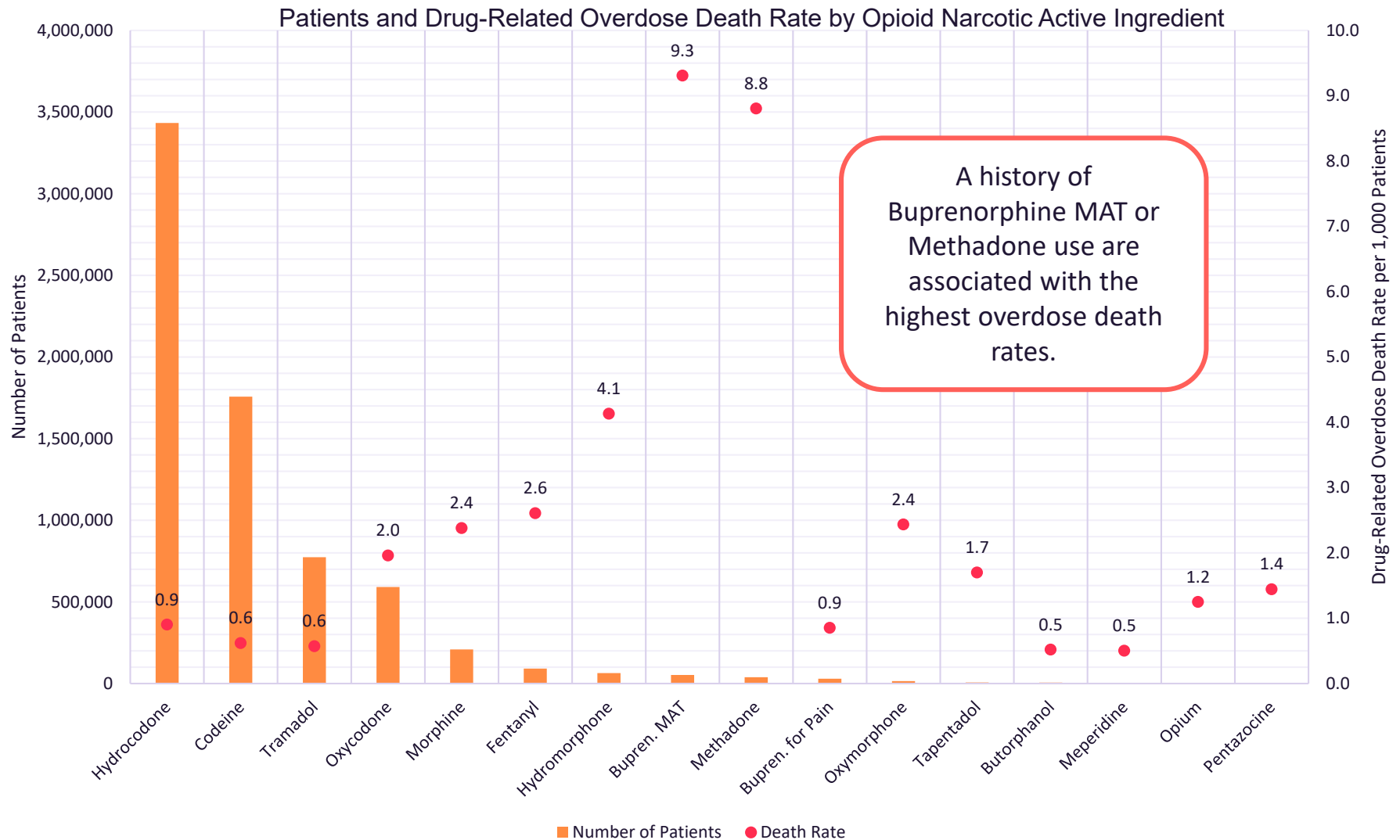# Drug-Related Overdose Deaths by Opioid Narcotic Active Ingredient

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Patients and Deaths by Opioid Narcotic Active Ingredient

In Michigan, among patients with at least one prescription of a drug type, **hydrocodone** had the most patients and the most deaths

Number of Deaths (Log Scale)

Number of Patients (Log Scale)

Drug-Related Overdose Deaths by Opioid Narcotic Active Ingredient

Highest death rates among patients who received at least one prescription of methadone (8.8 deaths per 1000 patients)

Size corresponds to proportion of prescriptions for that active ingredient type.
The buprenorphine category excludes Generic Sequence Numbers (GCN) for narcotic withdrawal therapy.
The darker the color, the higher the death rate
Inscribed percent is the corresponding death rate.
Source: Michigan PDMP data (2013-2015) and Michigan drug-related death data (2013-2015) linked to PDMP
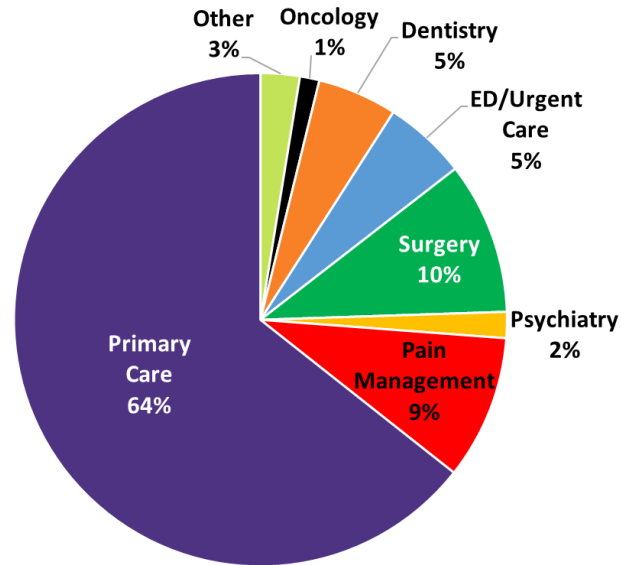
Deaths by Opioid Narcotic Active Ingredient

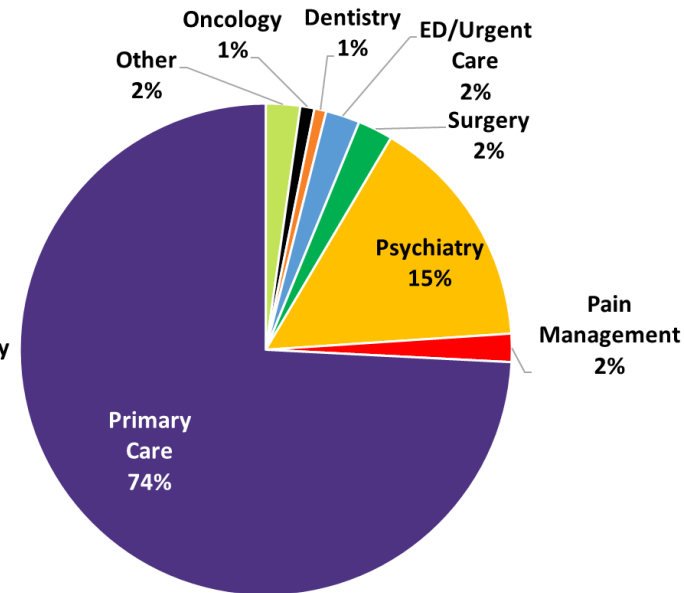Patients and Drug-Related Overdose Death Rate by Opioid Narcotic Active Ingredient

A history of Buprenorphine MAT or Methadone use are associated with the highest overdose death rates.

Data point labels (Death Rate): Hydrocodone 0.9, Codeine 0.6, Tramadol 0.6, Oxycodone 2.0, Morphine 2.4, Fentanyl 2.6, Hydromorphone 4.1, Bupren. MAT 9.3, Methadone 8.8, Bupren. for Pain 0.9, Oxymorphone 2.4, Tapentadol 1.7, Butorphanol 0.5, Meperidine 0.5, Opium 1.2, Pentazocine 1.4

Legend: ● Number of Patients ● Death Rate

Prescriber Characteristics

Prescriptions Written by Prescriber Specialty

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Number of Prescribers by Specialty
- Primary Care 59%
- Other 6%
- Oncology 2%
- Dentistry 7%
- ED/Urgent Care 4%
- Surgery 10%
- Psychiatry 10%
- Pain Management 3%
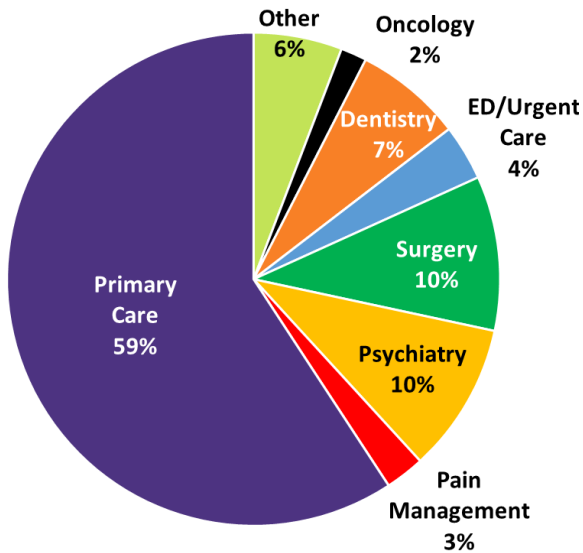
Number of Narcotic Prescriptions by Prescriber Specialty
- Primary Care 64%
- Other 3%
- Oncology 1%
- Dentistry 5%
- ED/Urgent Care 5%
- Surgery 10%
- Psychiatry 2%
- Pain Management 9%

Number of Sedative Prescriptions by Prescriber Specialty
- Primary Care 74%
- Other 2%
- Oncology 1%
- Dentistry 1%
- ED/Urgent Care 2%
- Surgery 2%
- Psychiatry 15%
- Pain Management 2%

- 59% of prescribers are in **primary care**
- 9% of narcotic prescriptions are written by **pain management** prescribers (3% of all prescribers)
- 15% of sedative prescriptions are written by **psychiatry** prescribers (10% of all prescribers)
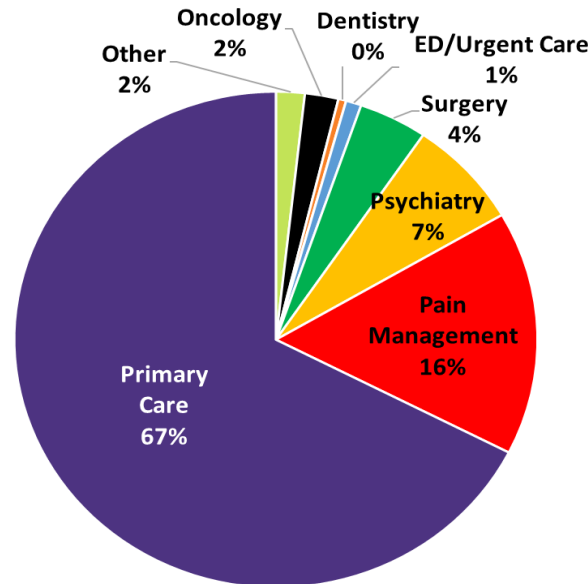
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Morphine Milligram Equivalency (MME) by Prescriber Specialty

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Number of Prescribers by Specialty

- Primary Care 59%
- Other 6%
- Oncology 2%
- Dentistry 7%
- ED/Urgent Care 4%
- Surgery 10%
- Psychiatry 10%
- Pain Management 3%
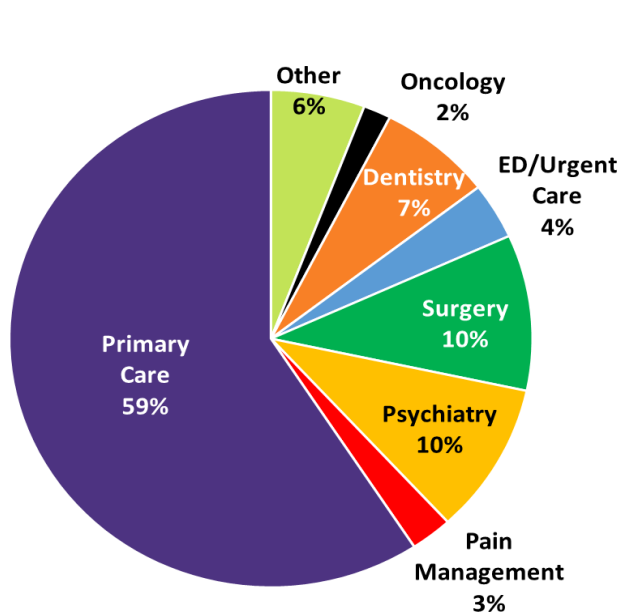
Aggregate MME of Prescription Fills by Prescriber Specialty

- Primary Care 67%
- Other 2%
- Oncology 2%
- Dentistry 0%
- ED/Urgent Care 1%
- Surgery 4%
- Psychiatry 7%
- Pain Management 16%

Pain management accounts for 16% of aggregate MMEs dispensed and the average MME per dispensation is 1.97 times that of primary care

Oncology's average MME per dispensation is twice that of primary care
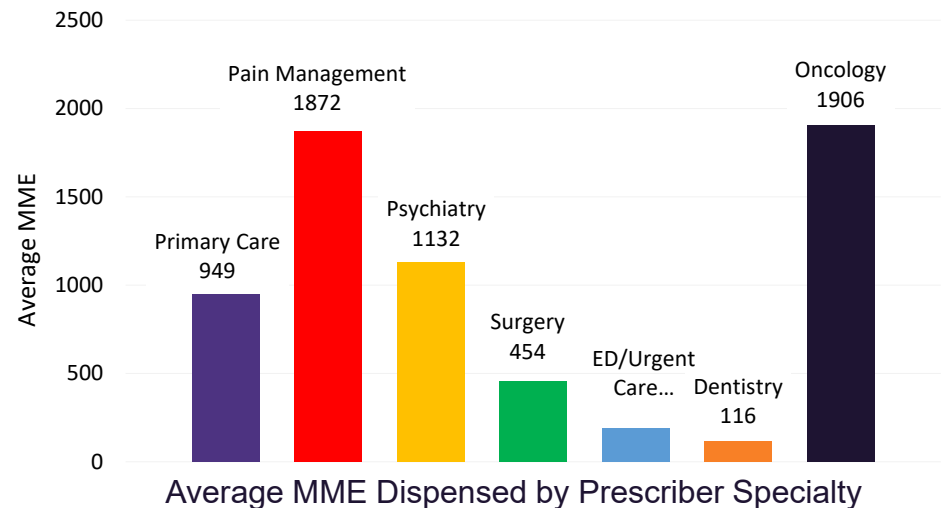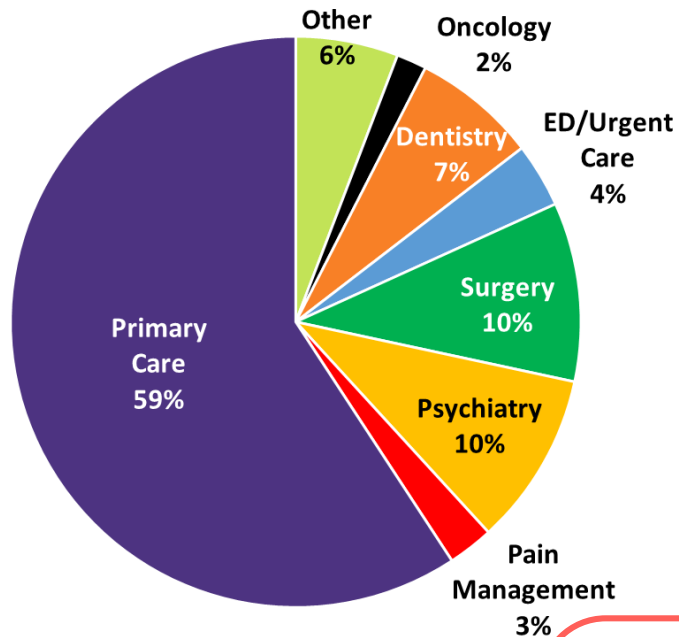

Average MME Dispensed by Prescriber Specialty

- Primary Care 949
- Pain Management 1872
- Psychiatry 1132
- Surgery 454
- ED/Urgent Care…
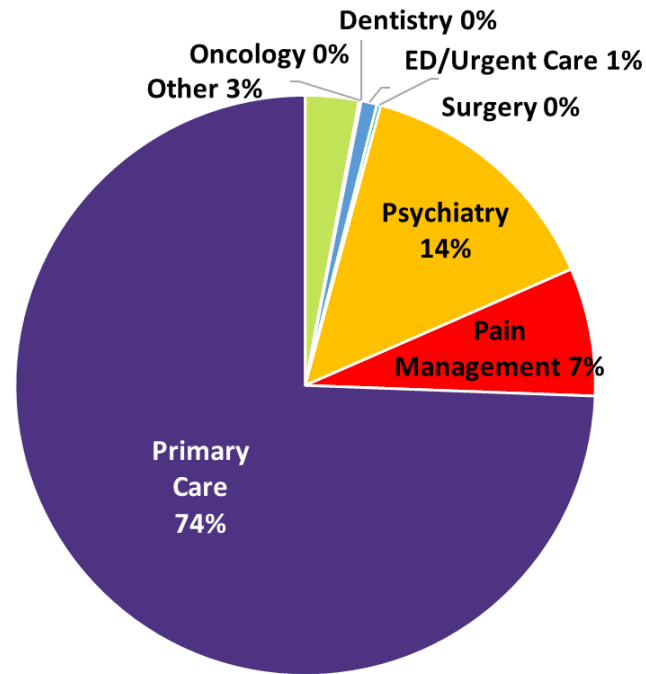- Dentistry 116
- Oncology 1906

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017 supplemented by NPPES NPI file
Note: Narcotic prescriptions exclude prescriptions classified as Buprenorphine MAT.
*Prescribers are characterized by their primary specialty. Narcotic MME excludes prescriptions classified as Buprenorphine MAT; Excludes prescribers missing primary specialty classification; Other specialties include specialties not classified elsewhere; MME= Number of Pills * Morphine Equivalent Units among Narcotic Prescriptions*

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Buprenorphine MAT by Prescriber Specialty

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Number of Prescribers by Specialty

- Other 6%
- Oncology 2%
- Dentistry 7%
- ED/Urgent Care 4%
- Surgery 10%
- Psychiatry 10%
- Primary Care 59%
- Pain Management 3%

Number of Buprenorphine MAT Prescriptions by Prescriber Specialty

- Dentistry 0%
- Oncology 0%
- Other 3%
- ED/Urgent Care 1%
- Surgery 0%
- Psychiatry 14%
- Pain Management 7%
- Primary Care 74%

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017 supplemented by NPPES NPI file
*Note: Prescribers are characterized by their primary specialty. Excludes prescribers missing primary specialty classification Other specialty includes specialties not classified elsewhere. Includes only prescriptions classified as Buprenorphine MAT. Buprenorphine Medication Assisted Therapy (MAT) includes all medication dispensations for NDCs falling under specific Generic Code Numbers (GCNs), including off-label use.*

- 59% of prescribers are in **primary care**, but primary care writes 74% of the MAT prescriptions
- 7% of MAT prescriptions are written by **pain management** prescribers (3% of all prescribers)
- 14% of MAT prescriptions are written by **psychiatry** prescribers (10% of all prescribers)

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Lorazepam Milligram Equivalency (LME) by Prescriber Specialty
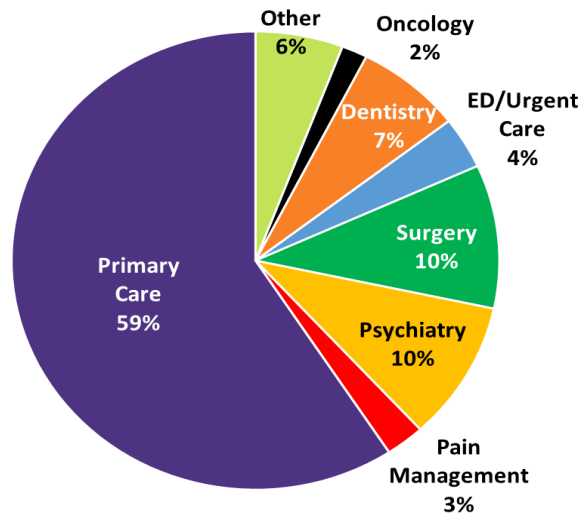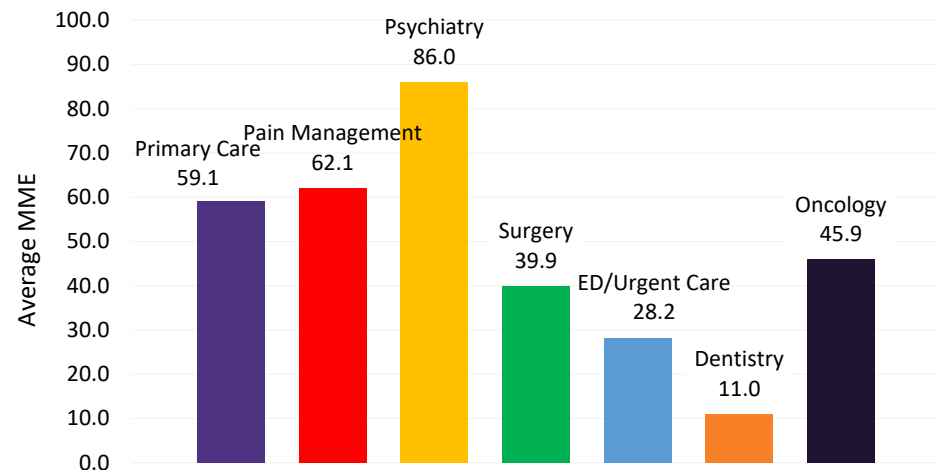

Number of Prescribers by Specialty
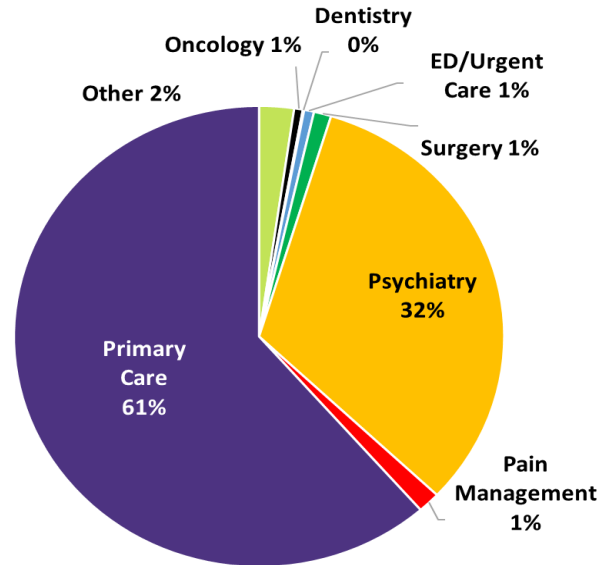
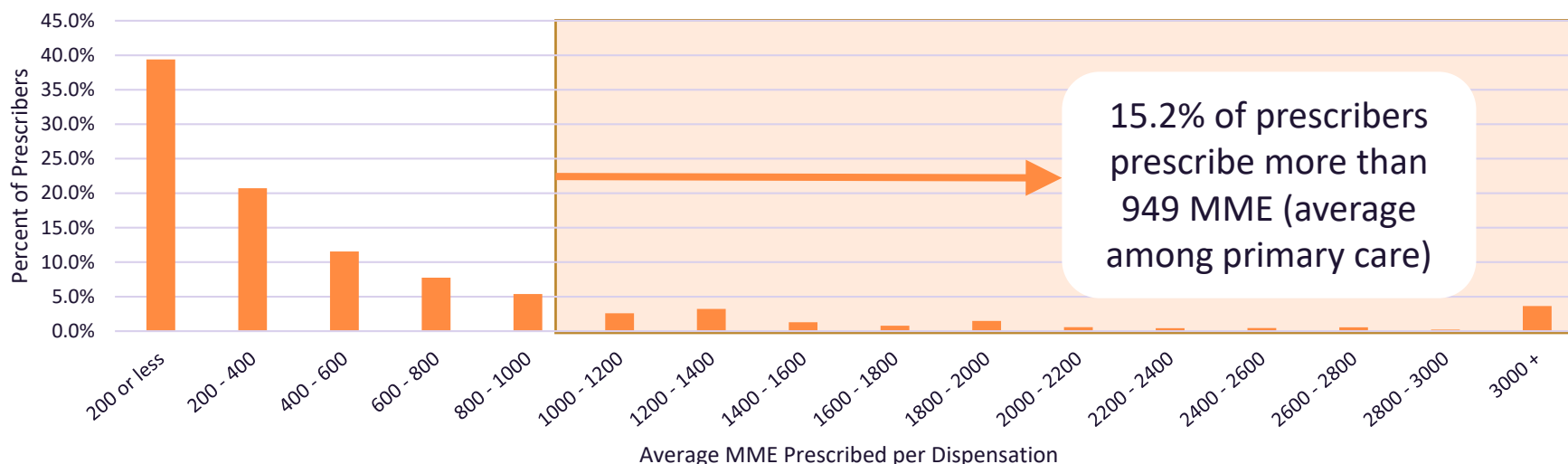Aggregate LME of Prescription Fills by Prescriber Specialty

Psychiatry accounts for 32% of aggregate LMEs dispensed and the specialty's average LME per dispensation is 86.0 (1.46 times that of primary care)
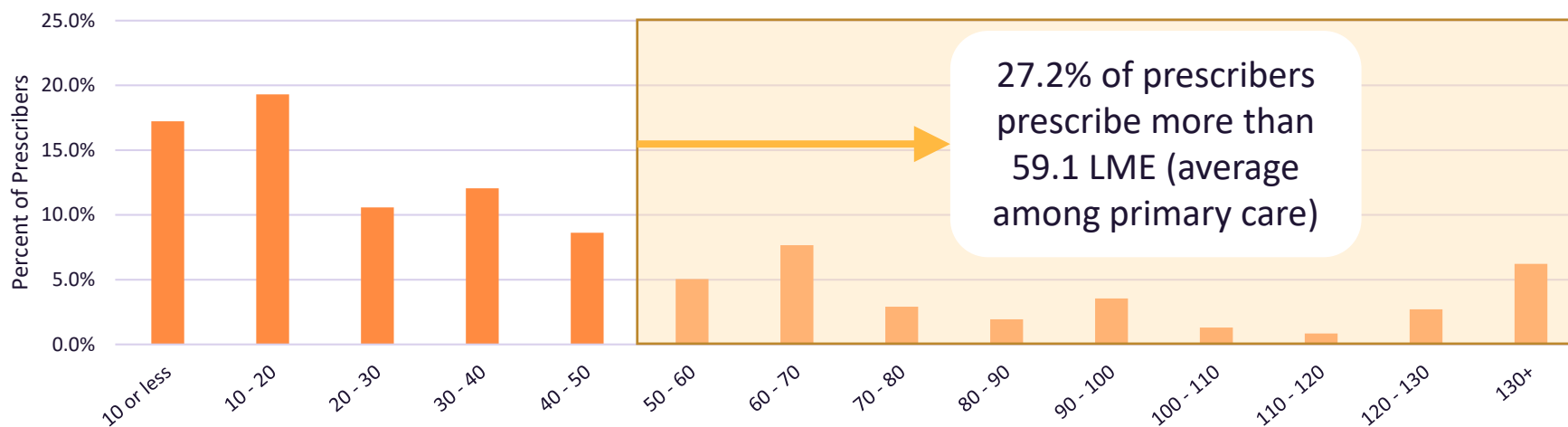

Average LME Dispensed by Prescriber Specialty

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017 supplemented by NPPES NPI file
Note: Excludes prescribers missing primary specialty classification
Other specialty includes specialties not classified elsewhere
*LME= Number of Pills * Lorazepam Equivalent Units among Sedative Prescriptions*

Distribution of Average MME/LME Prescribed

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Distribution of Prescribers by Average Narcotic MME Prescribed

15.2% of prescribers prescribe more than 949 MME (average among primary care)

Percent of Prescribers

Average MME Prescribed per Dispensation

X-axis categories: 200 or less, 200 - 400, 400 - 600, 600 - 800, 800 - 1000, 1000 - 1200, 1200 - 1400, 1400 - 1600, 1600 - 1800, 1800 - 2000, 2000 - 2200, 2200 - 2400, 2400 - 2600, 2600 - 2800, 2800 - 3000, 3000 +

Distribution of Prescribers by Average Sedative LME Prescribed

27.2% of prescribers prescribe more than 59.1 LME (average among primary care)

Percent of Prescribers

Average LME Prescribed per Dispensation

X-axis categories: 10 or less, 10 - 20, 20 - 30, 30 - 40, 40 - 50, 50 - 60, 60 - 70, 70 - 80, 80 - 90, 90 - 100, 100 - 110, 110 - 120, 120 - 130, 130+

Drug-Related Overdose Death Rate by Average MME/LME of <u>Prescribers</u>

Drug-Related Overdose Death Rate by Average Narcotic MME of Prescribers
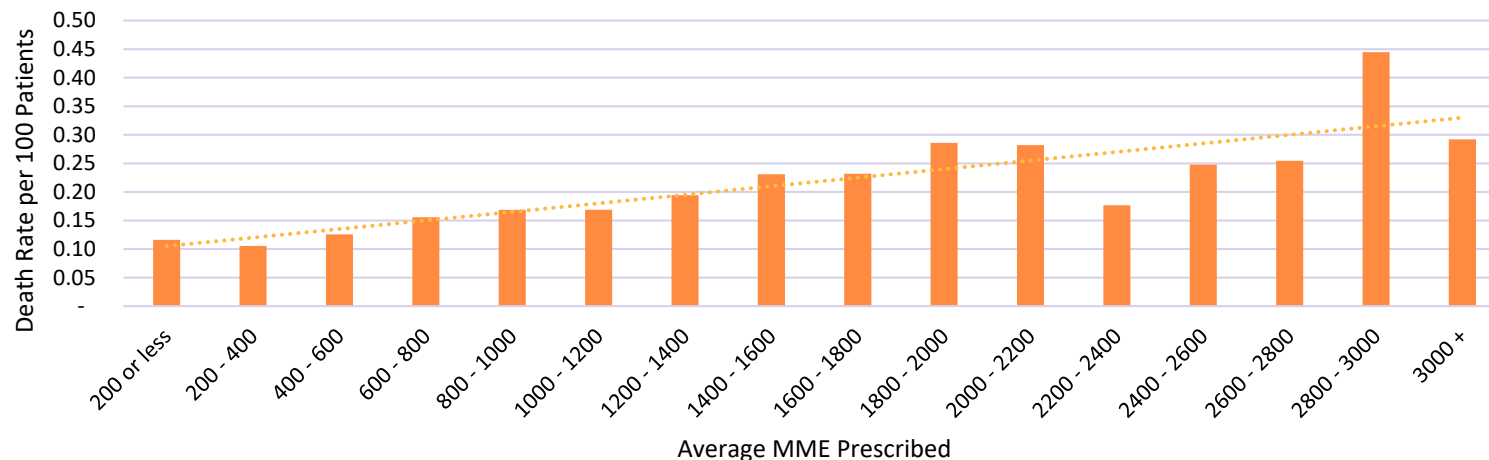
Drug-Related Overdose Death Rate by Average Sedative LME of Prescribers

Source: Michigan PDMP Data 2013-2015 and Michigan 2013-2015 drug-related deaths
*Note: Narcotic MME excludes prescriptions classified as Buprenorphine MAT; MME= Number of Pills * Morphine Equivalent*
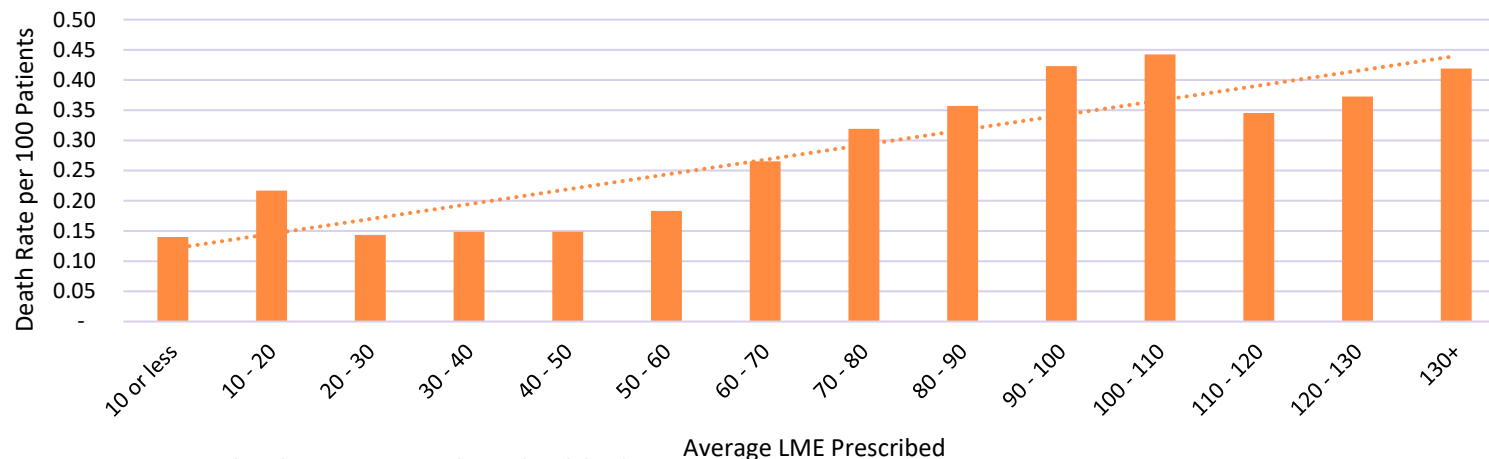*Units among Narcotic Prescriptions; LME= Number of Pills * Lorazepam Equivalent Units among Sedative Prescriptions*

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Vulnerable Subpopulations

Buprenorphine Medication-Assisted Treatment (MAT) Prescriptions and Deaths

- Patients with a Buprenorphine MAT prescription are already being treated for opioid use disorder, and are at higher risk of overdose death

- Certain types of Buprenorphine MAT are associated with higher death rates than others:
  - **Suboxone**
    - 9.7 deaths per 1,000 patients
  - **Buprenorphine-naloxone**
    - 8.5 deaths per 1,000 patients

- Methadone and other forms of MAT (naltrexone) are not reported to the PDMP and therefore not available for comparison.

Zubsolv 0.54%

Buprenorphn-Naloxon 0.85%

Butrans 0.24%

Bunavail 0.49%

Buprenorphine 0.30%

Suboxone 0.97%
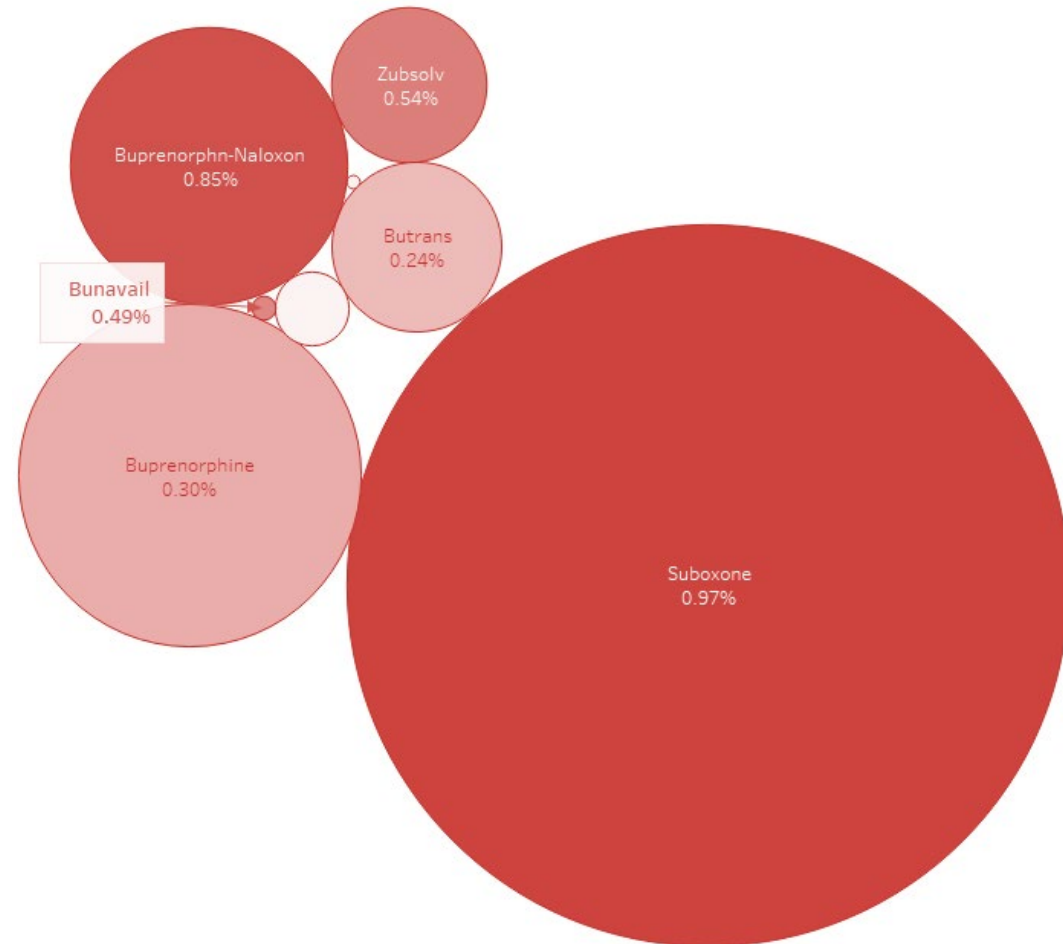
Size corresponds to proportion of prescriptions for that active ingredient type.
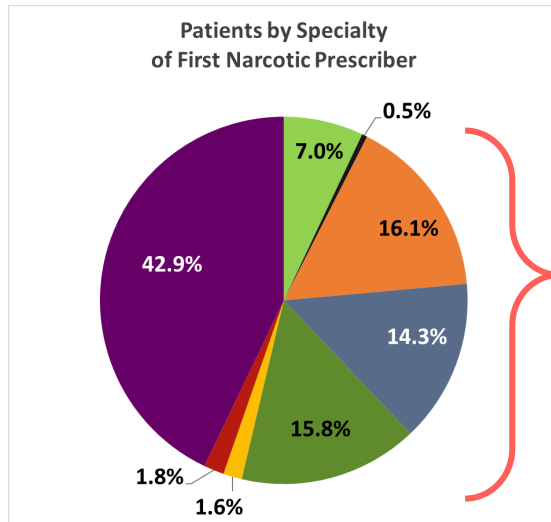*The darker the color, the higher the death rate*
Source: Michigan PDMP data (2013-2015) and Michigan drug-related death data (2013-2015) linked to PDMP.
Buprenorphine Medication Assisted Therapy (MAT) includes all medication dispensations for NDCs falling under specific Generic Code Numbers (GCNs), including off-label use.
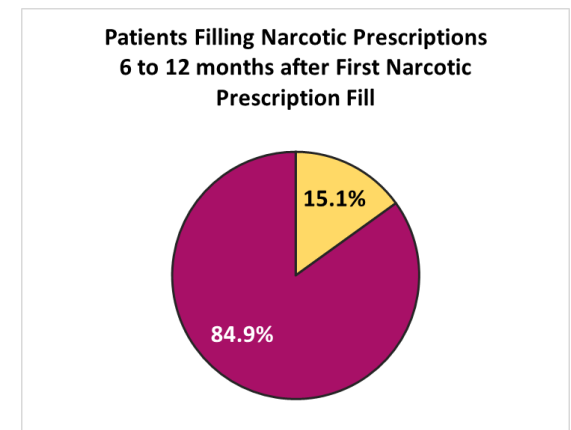
***First narcotic prescription* is defined as the first prescription written in 2014 or later for patients who had no fills in 2013 or prior (N=3,586,184 patients)**

Patients by Specialty of First Narcotic Prescriber

- Primary Care
- Pain Management
- Psychiatry
- Surgery
- ED/Urgent Care
- Dentistry
- Oncology
- Other

A large percentage of patients' first narcotic prescription are written in Surgery (15.8%), ED/Urgent Care (14.3%), and Dentistry (16.1%), though these specialties make up 10.2%, 3.6%, and 7.0% of prescribers, respectively

15.1% of patients are still filling narcotic prescriptions 6 months to 1 year after their first narcotic fill
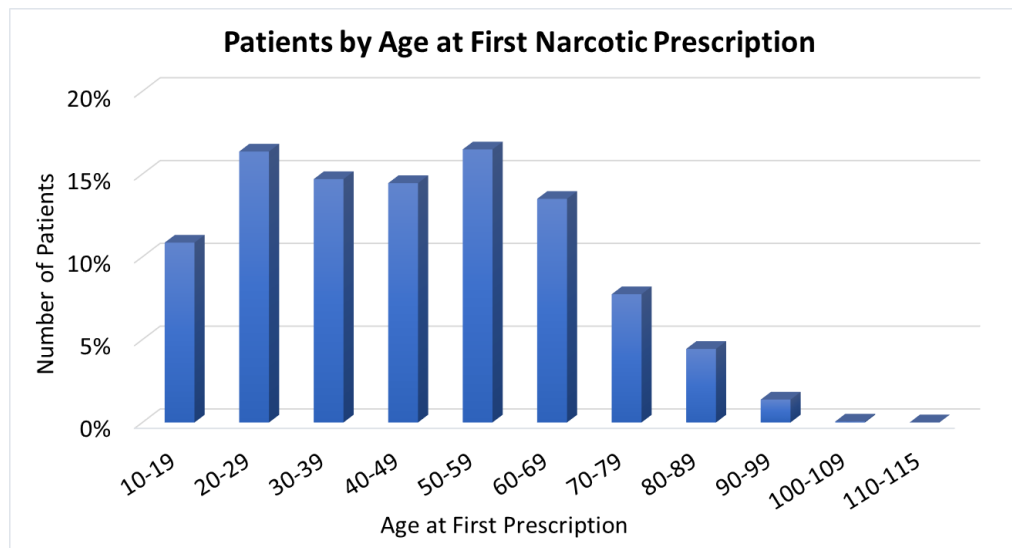
Patients Filling Narcotic Prescriptions 6 to 12 months after First Narcotic Prescription Fill

15.1%

84.9%

30

Patient Age at First Narcotic Prescription

- 45.7 is the average age when patients are written their first narcotic prescription
- 10.9% of patients were first prescribed narcotics before the age of 20 and 27.2% before the age of 30

Patients by Age at First Narcotic Prescription

(Bar chart: Number of Patients vs. Age at First Prescription)
Age groups: 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, 100-109, 110-115
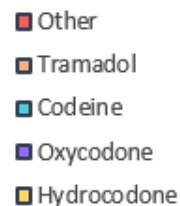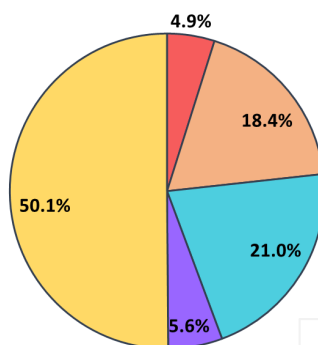

Patients Aged 19 or Younger by First Narcotic Medication Prescribed

- 0.9%
- 11.8%
- 30.0%
- 3.6%
- 53.7%
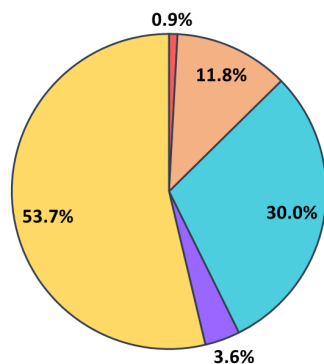
Patients Aged 50 or Older by First Narcotic Medication Prescribed

- 4.9%
- 18.4%
- 21.0%
- 5.6%
- 50.1%

Legend:
- Other
- Tramadol
- Codeine
- Oxycodone
- Hydrocodone

Younger patients (ages <20) are more likely to be prescribed codeine or hydrocodone as their first narcotic than older patients (ages 50+), who are more likely be prescribed oxycodone, tramadol, or another narcotic

Source: Michigan PDMP Oct. 23, 2012-Oct. 23, 2017
First narcotic prescriptions were written in 2014 or later; criteria used due to insufficient prescription data prior to 2013
Excludes patients younger than 10 and older than 115 at their incident prescription.

Time from First Narcotic Prescription to OD Death

Among patients whose first narcotic prescriptions were written between 2014 and 2015, those who died of a drug overdose were prescribed narcotics for only 8 months prior to death, on average

Time from First Narcotic Prescription to OD Death

X-axis: Months on Narcotic
Y-axis: Number of Patients
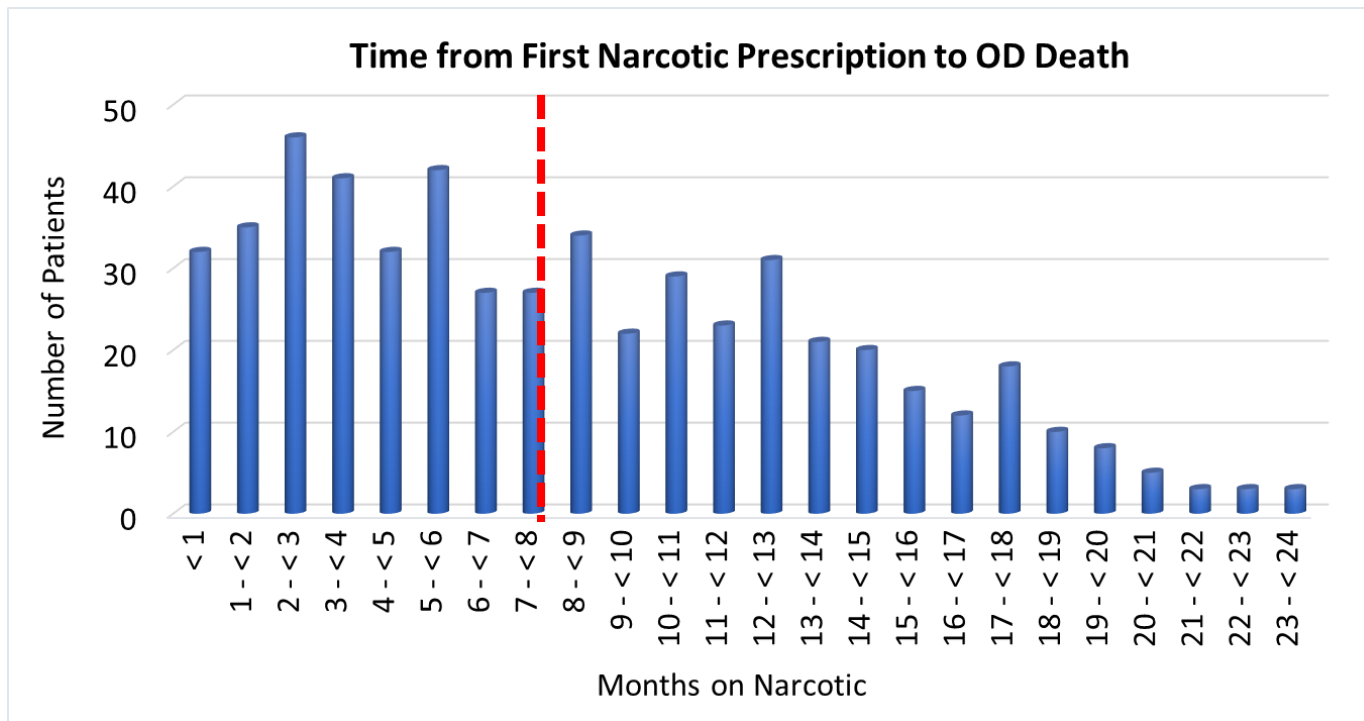
The Overdose Risk Score (ORS)

Overview of Appriss' Overdose Risk Score
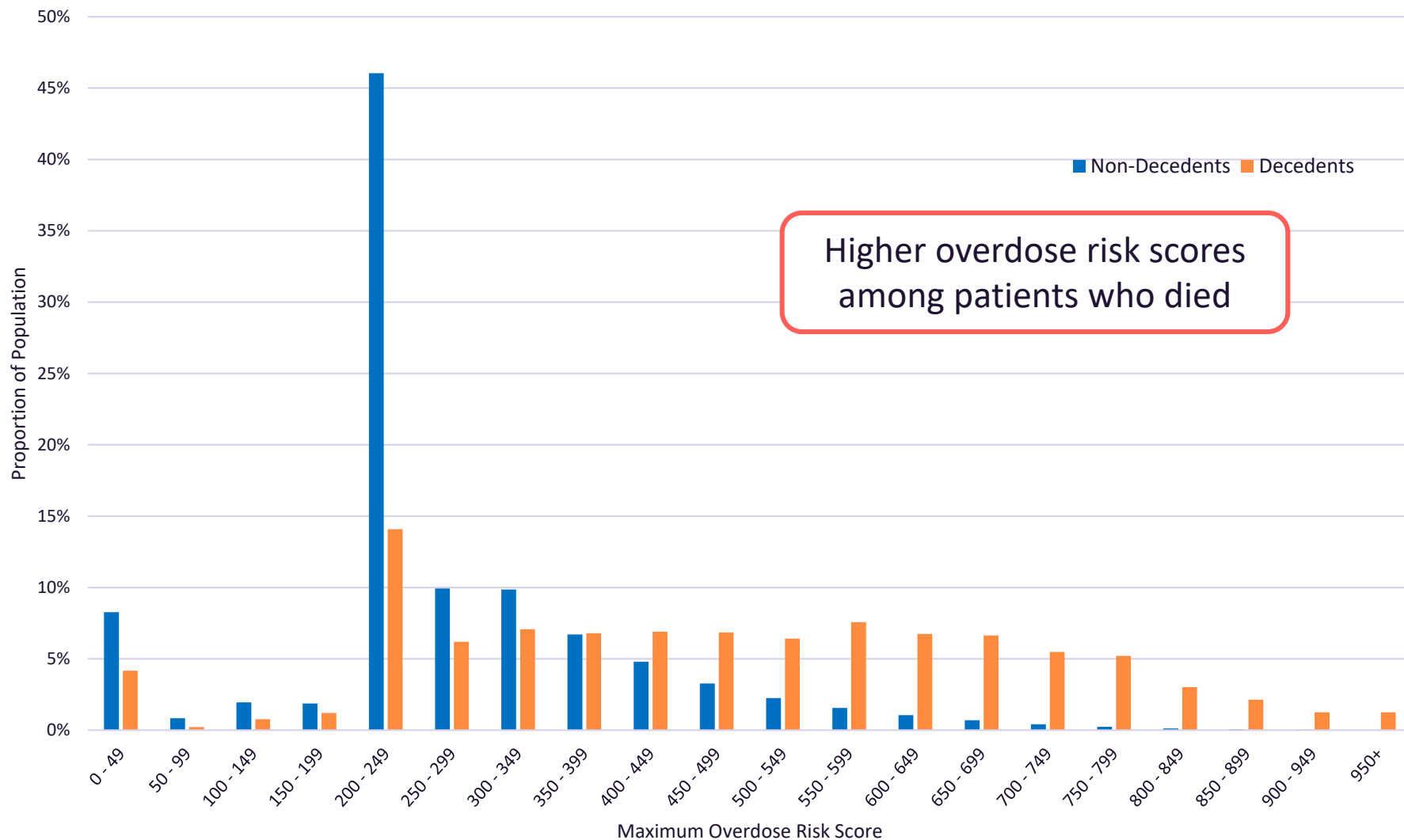
APPRISS HEALTH

- Appriss has created a proprietary risk score that predicts the likelihood of a drug-related death, taking into account a variety of patient characteristics

- The risk score ranges from 0 to 999

- NarxCare is live today in these states: CT, OH, IN, VA, SC, MI, AZ, CO, NV, ID, WV, & NJ

- NarxCare contracts have been signed in these states and will be implemented soon: TX & PA

Overdose Risk Score Range	Odds Ratio (95% CI)
0-200	Ref.
201-300	1.70 (1.39, 2.06)
301-400	2.68 (2.22, 3.23)
401-500	5.28 (4.39, 6.35)
501-600	11.01 (9.18, 13.20)
601-700	30.20 (24.95, 36.56)
701-800	64.10 (51.97, 79.06)
801-900	55.61 (41.55, 74.43)
901-999	350.83 (211.89, 580.88)

350 times more likely to die of a drug-related death than people with an OD score less than 200

Note: Odds ratios are calculated using case-control sampling. Excludes decedents whose death was prior to 2015, as 2 years of prescription history data not available. For every death, 100 random controls are selected who had a prescription within the year preceding the date of death of the case. For both cases and controls, their maximum overdose risk score within that year period was taken as their exposure.

Overdose Risk Scores Distribution

Higher overdose risk scores among patients who died

Legend: ■ Non-Decedents ■ Decedents

Y-axis: Proportion of Population (0% to 50%)
X-axis: Maximum Overdose Risk Score (0-49, 50-99, 100-149, 150-199, 200-249, 250-299, 300-349, 350-399, 400-449, 450-499, 500-549, 550-599, 600-649, 650-699, 700-749, 750-799, 800-849, 850-899, 900-949, 950+)

Source: Michigan PDMP 2013-2015 and Michigan 2015 drug-related deaths
Note: Excludes decedents whose death was prior to 2015, because 2 years of prescription history data not available. Overdose Risk Score is the maximum over the entire PDMP history for that patient

Drug-Related Overdose Death Rate by Overdose Risk Scores

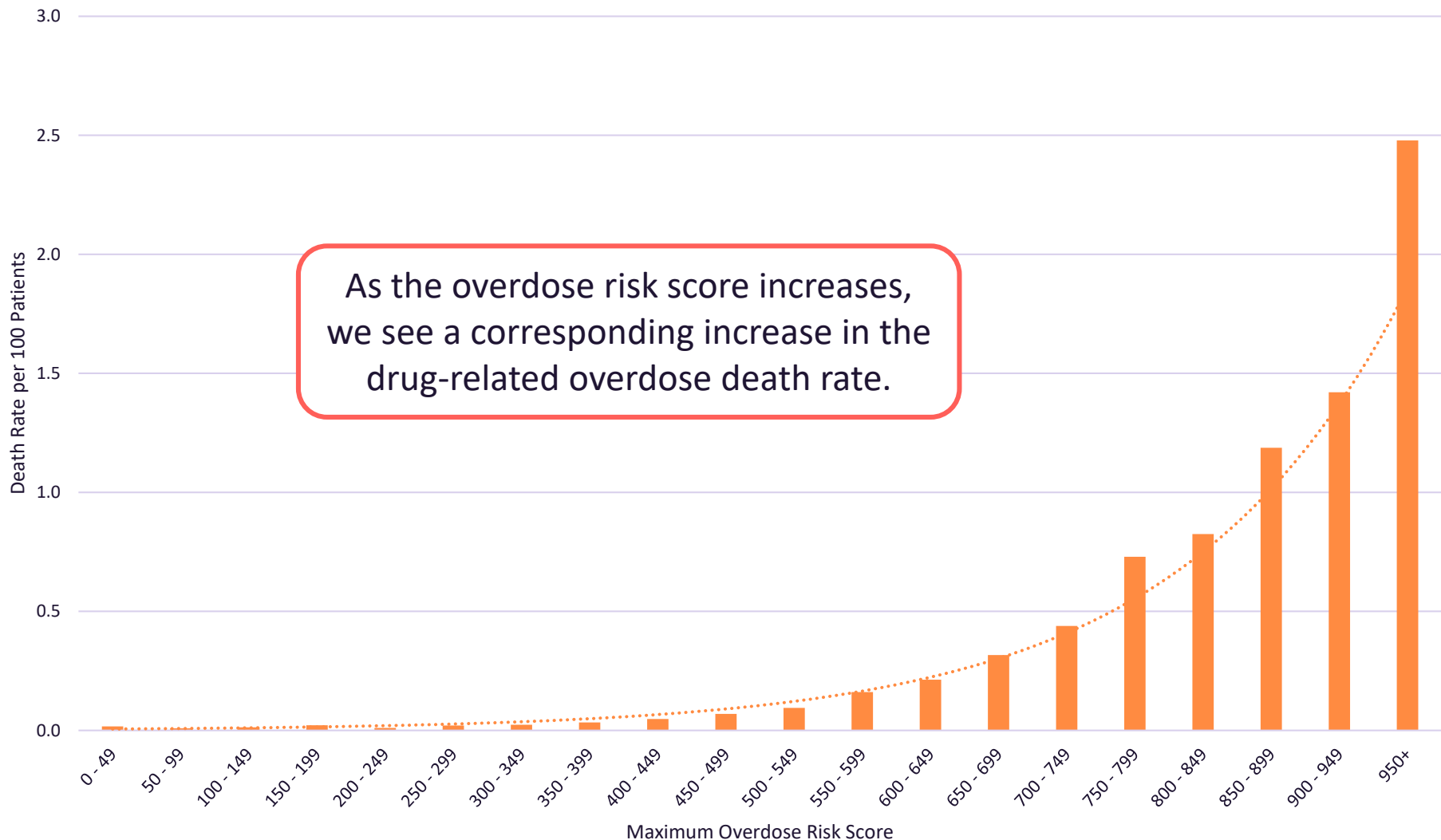As the overdose risk score increases, we see a corresponding increase in the drug-related overdose death rate.

Source: Michigan PDMP 2013-2015 and Michigan 2015 drug-related deaths
Note: Excludes decedents whose death was prior to 2015, because 2 years of prescription history data not available. Overdose Risk Score is the maximum over the entire PDMP history for that patient

Distribution of Overdose Risk Score Over Time
All 2015 Michigan Decedents

Distribution of Overdose Risk Score by Days Pre-Death

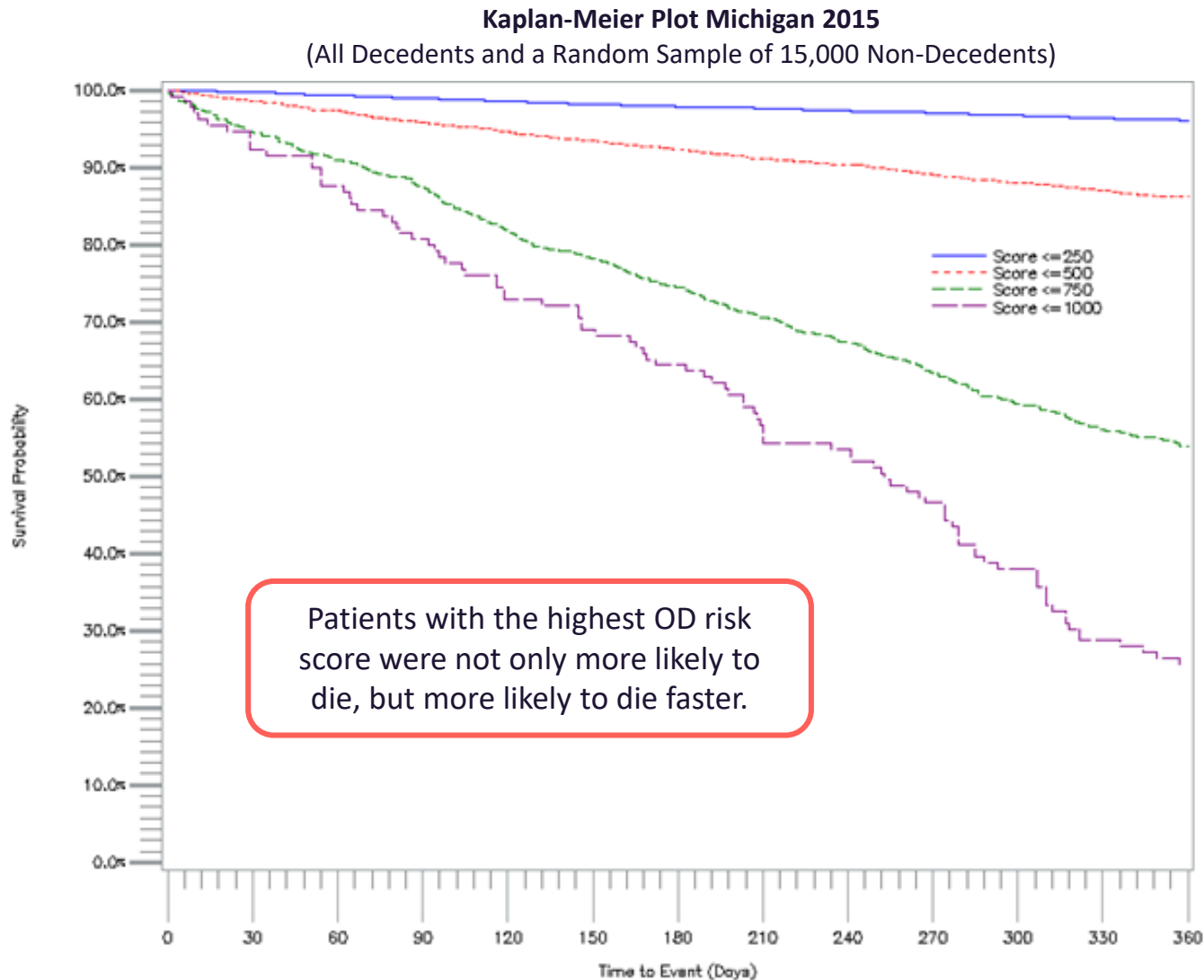Patients who died tended to have their highest OD Risk score in the year immediately preceding death

Source: Michigan PDMP 2013-2015 and Michigan 2015 drug-related deaths
Note: Excludes decedents whose death was prior to 2015, because 2 years of prescription history data not available

37
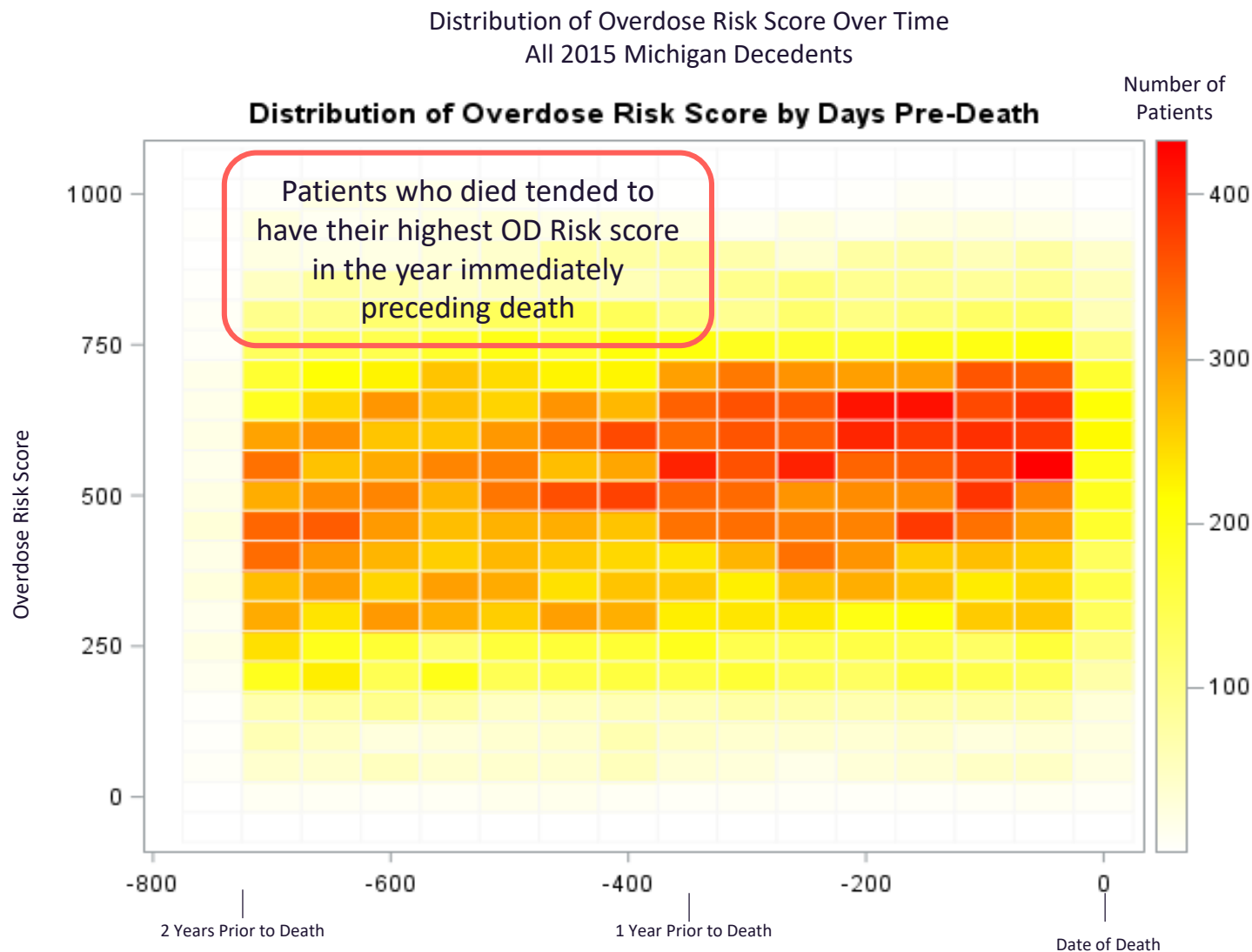
Overdose Risk Score Kaplan-Meier Plot

Kaplan-Meier Plot Michigan 2015
(All Decedents and a Random Sample of 15,000 Non-Decedents)

Legend:
- Score <=250
- Score <=500
- Score <=750
- Score <=1000

Patients with the highest OD risk score were not only more likely to die, but more likely to die faster.
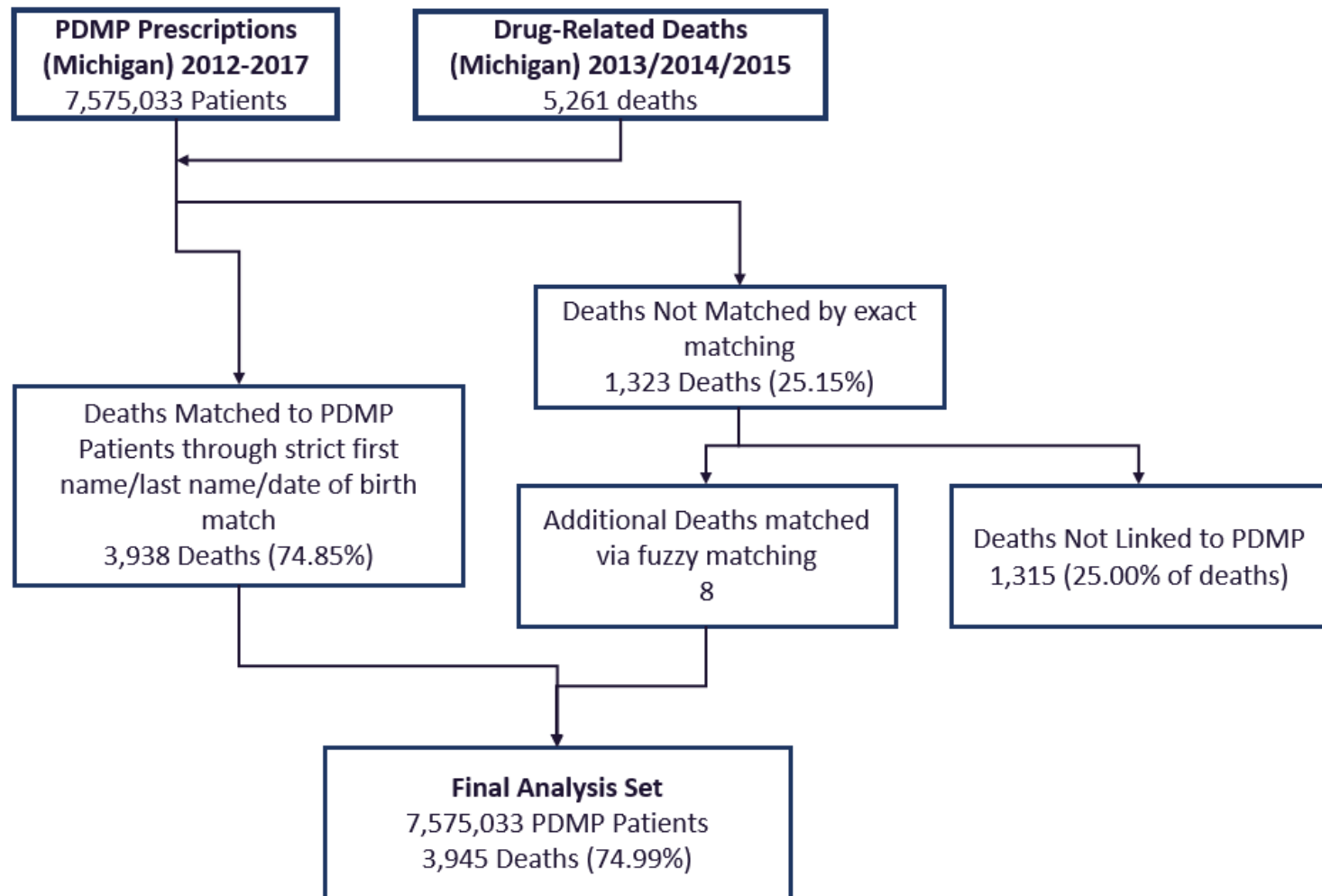
Source: Michigan PDMP Oct. 23, 2012-Dec.31, 2014 and Michigan 2015 drug-related deaths
Note: Includes all decedents from 2015 and a random sample of 15,000 non-decedents. Day 0 is Jan 1, 2015. ODS Score is the last score calculated for each patient in 2014. Patients had to have had a fill during 2014.

Take Home Points

- While the number of dispensations of II-IV drugs were relatively stable to slightly decreasing during the study period the number of overdose related deaths have been increasing.

- Men are at greater overall risk of overdose death than women, especially between the ages of 26-55. Women have their great risk of overdose death between ages 46 – 55.

- Overdose death counts by location generally mirror population levels. Death *rates* by location do vary with some areas having more than 3 times the average risk throughout the state.

- Overdose death rates generally correlate with the amount of medication used, the number of providers seen, and the number of pharmacies visited.

- The rate of controlled substance prescribing is generally consistent across specialties with the exception that pain specialists tend to write more and stronger opioid prescriptions and psychiatrists tend to write more and stronger sedative prescriptions.

- A *history* of Buprenorphine use for MAT and Methadone use for pain are associated with higher overdose death rates. Importantly, nothing in this study indicates these medications *cause* an increased overdose death rate, and in fact, buprenorphine has been shown to decrease overdose deaths in the population of patients who have opioid use disorder.

- Primary Care, Surgery, ED/Urgent Care, and Dentists are the source of 90% of all first opioid fills

- 15% of patients are still using opioids 6 months after their first fill

- The Overdose Risk Score is strongly associated with risk of overdose death within the next year

Appendix

Michigan Drug-Related Deaths ('13, '14, '15) and PDMP Prescriptions October 23, '12 to October 23, '17

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PDMP Prescriptions (Michigan) 2012-2017
7,575,033 Patients

Drug-Related Deaths (Michigan) 2013/2014/2015
5,261 deaths

Deaths Not Matched by exact matching
1,323 Deaths (25.15%)

Deaths Matched to PDMP Patients through strict first name/last name/date of birth match
3,938 Deaths (74.85%)

Additional Deaths matched via fuzzy matching
8

Deaths Not Linked to PDMP
1,315 (25.00% of deaths)

Final Analysis Set
7,575,033 PDMP Patients
3,945 Deaths (74.99%)

Note: Drug-related deaths include deaths unrelated to prescription drug use (e.g., heroin).