# PRESCRIPTION DRUG OVERDOSE PROGRAM 2018 REPORT:

## Understanding and responding to the opioid epidemic in Tennessee using Mortality, Morbidity, and Prescription Data

*Report on epidemiologic data, efforts, and collaborations to address the opioid epidemic in TN*

Office of Informatics and Analytics
Tennessee Department of Health

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TN Department of Health


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**For additional information about program and team members:**

Visit our web page at: https://www.tn.gov/health/health-program-areas/pdo/pdo/who-we-are.html

This report only provides selected data and measures for summary purposes. Additional data are available:

- On the TN Drug Overdose Data Dashboard, including county-level data and reports: https://www.tn.gov/health/health-program-areas/pdo/pdo/data-dashboard.html
- By request (email: Prescription.Drugs@tn.gov) with available measures listed in the Appendix (**Appendix A**)

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# Abbreviations

| Abbreviations | Title |
|---|---|
| **CDC** | Centers for Disease Control and Prevention |
| **CSMD** | Controlled Substance Monitoring Database |
| **CSTE** | Council of State and Territorial Epidemiologists |
| **DEA** | Drug Enforcement Administration |
| **DOR** | Drug Overdose Reporting |
| **ESOOS** | Enhanced State Opioid Overdose Surveillance |
| **FDA** | Food and Drug Administration |
| **HDDS** | Hospital Discharge Data System |
| **HEW** | Health Enterprise Warehouse |
| **ICD-10** | International Classification of Diseases, 10th Revision |
| **ICD-9-CM** | International Classification of Diseases, 9th Revision, Clinical Modification |
| **ICD-10-CM** | International Classification of Diseases, 10th Revision, Clinical Modification |
| **IDS** | Integrated Data System |
| **MAT** | Medication-Assisted Treatment |
| **MME** | Morphine Milligram Equivalent |
| **MPE** | Multiple Provider Episode |
| **NAS** | Neonatal Abstinence Syndrome |
| **NCHS** | National Center for Health Statistics |
| **OIA** | Office of Informatics and Analytics |
| **PDMP** | Prescription Drug Monitoring Program |
| **PDO** | Prescription Drug Overdose |
| **SA** | Short-Acting |
| **SUDOR** | State Unintentional Drug Overdose Reporting System |
| **TCA** | Tennessee Code Annotated |
| **TDH** | Tennessee Department of Health |

# Executive Summary

Tennessee (TN) continues to face a severe opioid crisis. From 2013 to 2016, age-adjusted rates of all drug overdose deaths increased from 17.8 per 100,000 TN residents to 24.6 per 100,000 TN residents, regardless of race and sex. During this same time, the number of heroin overdose deaths increased over 300% (63 deaths in 2013 to 260 deaths in 2016) and fentanyl emerged as a new public health crisis. The number of overdose deaths involving fentanyl, largely due to illicitly manufactured fentanyl, increased over 450% (53 deaths in 2013 to 294 deaths in 2016). Opioid and benzodiazepine deaths also have continued to increase, and close to 1/3rd of drug overdose decedents filled a prescription for a benzodiazepine within 60 days of death in 2016.

The Office of Informatics and Analytics at the Tennessee Department of Health (TDH) has developed a comprehensive and multi-faceted data-driven response to the opioid epidemic in TN using prescribing, mortality, and morbidity epidemiologic data, and dissemination of data through collaborative statewide efforts. This includes the development of an integrated data system and enterprise health warehouse, provision of data to communities via a new dashboard, conduct of rigorous analytics and studies, enhancement of surveillance systems for nonfatal and fatal overdoses and integration of law enforcement, mental health and health data for programmatic response. This report provides key epidemiologic data on risk measures and trends to understand and respond to the opioid epidemic in TN. This report also provides a broad summary of ongoing Prescription Drug Overdose program efforts, including available data, ongoing analyses and collaborations to address the opioid epidemic in TN. We briefly summarize here a few key selected epidemiologic data trends:

**Opioid overdose deaths continue to increase in TN through 2016, and most involve more than one contributing drug (Mortality data section, starting page: 26)**

- The rate of all opioid overdose deaths increased with an age-adjusted rate of 11.0 per 100,000 in 2012 and an age-adjusted rate of 18.1 per 100,000 in 2016.
- Natural and semi-synthetic prescription opioid death rates (excluding synthetic opioids such as fentanyl), while on the rise since 2012, appeared to be increasing at a small rate (9.7 per 100,000 in 2015 and 10.2 per 100,000 in 2016).
- Deaths due to combined opioid (any type) and benzodiazepine use continue to increase, with an age-adjusted rate of 4.0 per 100,000 in 2012 and 8.1 per 100,000 in 2016.
- Methadone deaths were the only opioid overdose type with a decrease observed between 2012 (1.7 per 100,000) and 2016 (1.3 per 100,000).
- The proportion of opioid overdose deaths identified as involving more than one drug increased from 63% in 2012 to 80% in 2016.

**Drug overdose deaths due to illicit opioids are increasing substantially (Mortality data section, starting page: 26)**

- The number of heroin overdose deaths increased from 63 deaths in 2013 to 260 deaths in 2016, and the age-adjusted rate increased from 1.0 per 100,000 in 2013 to 4.1 per 100,000 in 2016. In 2016, 70% of heroin decedents were male (30% were female) and 87% were White (13% were Black).

- Age-adjusted rates of fentanyl increased from 0.81 per 100,000 in 2013 (first year with available data) to 4.6 per 100,000 in 2016. In 2016, 67% of fentanyl overdose decedents were male (33% were female) and 83% were White (17% were Black).
- The proportion of all overdose deaths involving fentanyl increased from 4.5% in 2013 to 18.0% in 2016. The proportion of all drug overdose deaths involving heroin increased from 5.4% in 2013 to 15.9% in 2016.

**Non-fatal heroin overdoses are rapidly increasing based on hospital discharge data through 2016 in TN (Morbidity data section, starting page: 41)**

- Between 2014 and 2016, the age-adjusted rate of heroin outpatient visits increased from 5.2 per 100,000 to 21.1 per 100,000. Increases were seen for Whites (6.3 per 100,000 in 2014 and 24.1 per 100,000 in 2016) and Blacks (1.4 per 100,000 in 2014 and 8.7 per 100,000 in 2016).

**Number of prescriptions in TN, 2013 to 2017 (Prescribing data section, starting page: 8)**:

- The number of prescriptions for opioids for pain has decreased from about 2 million in the first quarter of 2013 to just over 1.6 million (242.1 per 1,000 residents) in the last quarter of 2017. This trend was observed for almost all counties in TN. The 3 most commonly prescribed short-acting opioids for pain in TN are hydrocodone, oxycodone, and tramadol, respectively, and they account for about 85% of all opioid prescriptions for pain in TN.
- The number of prescriptions for benzodiazepines decreased from 965,312 in the first quarter of 2013 to about 860,000 in the last quarter of 2017 (128.9 per 1,000 residents). The top 4 most commonly prescribed benzodiazepines in TN are alprazolam, clonazepam, lorazepam, and diazepam, respectively, and they account for over 90% of all benzodiazepine prescriptions filled each year.
- In contrast to the trends observed for prescriptions for opioids for pain and benzodiazepines, prescriptions filled for buprenorphine for medication-assisted treatment increased from approximately 130,000 prescriptions in the first quarter of 2013 (20.3 per 1,000 residents) to over 220,000 in the last quarter of 2017 (33.7 per 1,000 residents).

**High MME prescriptions, overlapping opioid and benzodiazepine prescriptions, and multiple provider episodes (Prescribing data section, starting page: 8)**

- During 2013 to 2017, per capita daily morphine milligram equivalents (MME) declined across the majority of TN counties or remained stable (within 10%).
- The number of patients filling opioid prescriptions for pain for >90 MME decreased from 2013 to 2017, with the reduction primarily among patients who filled prescriptions for > 120 daily MME. The percentage of patients who filled prescriptions for >90 daily MME decreased from 11.6% at the beginning of 2013 to 9.2% at the end of 2017.
- The percentage of patients filling opioid prescriptions for pain who had overlapping benzodiazepine prescriptions (>1 overlapping day) decreased steadily from 9.8% in early 2013 to 7.1% at the end of 2017.

- The rate of multiple provider episodes has declined from 49.6 per 100,000 residents in the first half of 2013 to 14.7 per 100,000 residents in the second half of 2017.

**Prescription history in the CSMD in the year before death among all drug overdose decedents (Population highlight, page 56)**

- 78% of all drug overdose decedents filled any prescription in the CSMD in the year before death in 2013, and this decreased to 66% in 2016.
- 61% filled any prescription in the CSMD within 60 days of their death in 2013, and this decreased to 47% in 2016.
- The proportion with any prescription filled within 60 days of death among heroin overdose decedents slightly decreased during 2013 and 2016 (38% to 34%). The proportion who died of a fentanyl overdose with any prescription filled within 60 days of death substantially decreased from 77% in 2013 to 36% in 2016.
- The percent of all drug overdose decedents who filled an opioid prescription within 60 days of death decreased from 52% in 2013 to 37% in 2016.

The information presented in this report is an overview of ongoing work and provides selected key risk measures and data trends. Additional data are available with epidemiologic analyses ongoing and the continual development of analyses to be responsive to the needs of the opioid epidemic. The TDH Drug Overdose Dashboard provides state, region, and county-level data for key selected risk measures and is continually expanding: https://www.tn.gov/health/health-program-areas/pdo/pdo/data-dashboard.html

Additional sections of the report provide an overview of each of the following:

- Ongoing epidemiologic analyses
- Our data-driven support of licensure and over-prescribing investigations
- Dissemination of data at the county level
- The development of a statewide drug overdose reporting system for healthcare facilities
- A new grant to further enhance surveillance of both nonfatal and fatal overdoses
- A summary of the Hal Rogers grant, which provides key support for collaboration with mental health and law enforcement through data sharing
- Indicators that are currently being tracked in an ongoing way through the integrated data system
- The development, specifications and purpose of the integrated data system

# Opioid Prescription-Related Risk Measures in Tennessee, 2013- 2017

## Introduction

The Controlled Substance Monitoring Database (CSMD) is Tennessee's prescription drug monitoring program, which provides information about opioid prescribing patterns for patients, dispensers, and healthcare providers.[1] Schedule II, III, IV, and V controlled substance prescriptions filled in Tennessee (TN) are required to be entered into the CSMD. Dispensers are generally required to report all controlled substances dispensed within one business day, with the exception of veterinary dispensers, who report within 14 days. Healthcare providers are required to use the CSMD to query a patient's prescription history when beginning a new course of treatment and annually thereafter or when they have concerns. Dispensing data are uploaded to the state's vendor, Appriss, and daily updates are provided to the Office of Informatics and Analytics (OIA) for analytic purposes, accessible through the Integrated Data System, described in **Appendix B**.

CSMD data include information about each filled prescription for a controlled substance including the specific drug prescribed, National Drug Code number, strength, quantity, and days supply.[2] In order to monitor the prescription histories of individuals, the data includes identifying information about patients including full name, date of birth, gender, and street address. Additional information includes the prescriber's and dispenser's DEA number and address as registered with the DEA for each prescription.

The OIA uses the CSMD to create indicators of TN prescribing patterns at the prescription, patient, and prescriber levels. A number of data quality measures have been put into place to ensure accurate reporting of prescription indicators. For example, out of state prescriptions and prescriptions with implausible values are removed.[3] Additional drug information is added to the existing data by joining it to drug classification tables provided by the Centers for Disease Control and Prevention (CDC),[4] including major classes of drugs in the CSMD (i.e., opioids, benzodiazepines, stimulants, muscle relaxants), type of drugs (e.g., hydrocodone, oxycodone), strength, and oral morphine equivalent conversion factors. Due to the nature of data collection, a single individual may have a number of separate patient records (each may be associated with 1 or more prescriptions) in the CSMD that must be resolved into a single entity in a process referred to as entity management. Our current approach utilizes full names and dates of birth for primary matches. See ***Future Work*** section below for additional information about ongoing entity management projects for the CSMD and the ***Ongoing PDO team CDC-funded analytic projects*** section below for current projects utilizing the CSMD at TDH. After implementing data quality methods, indicators are calculated according to CDC guidelines[5] and TDH needs (see **Appendix A** for list of

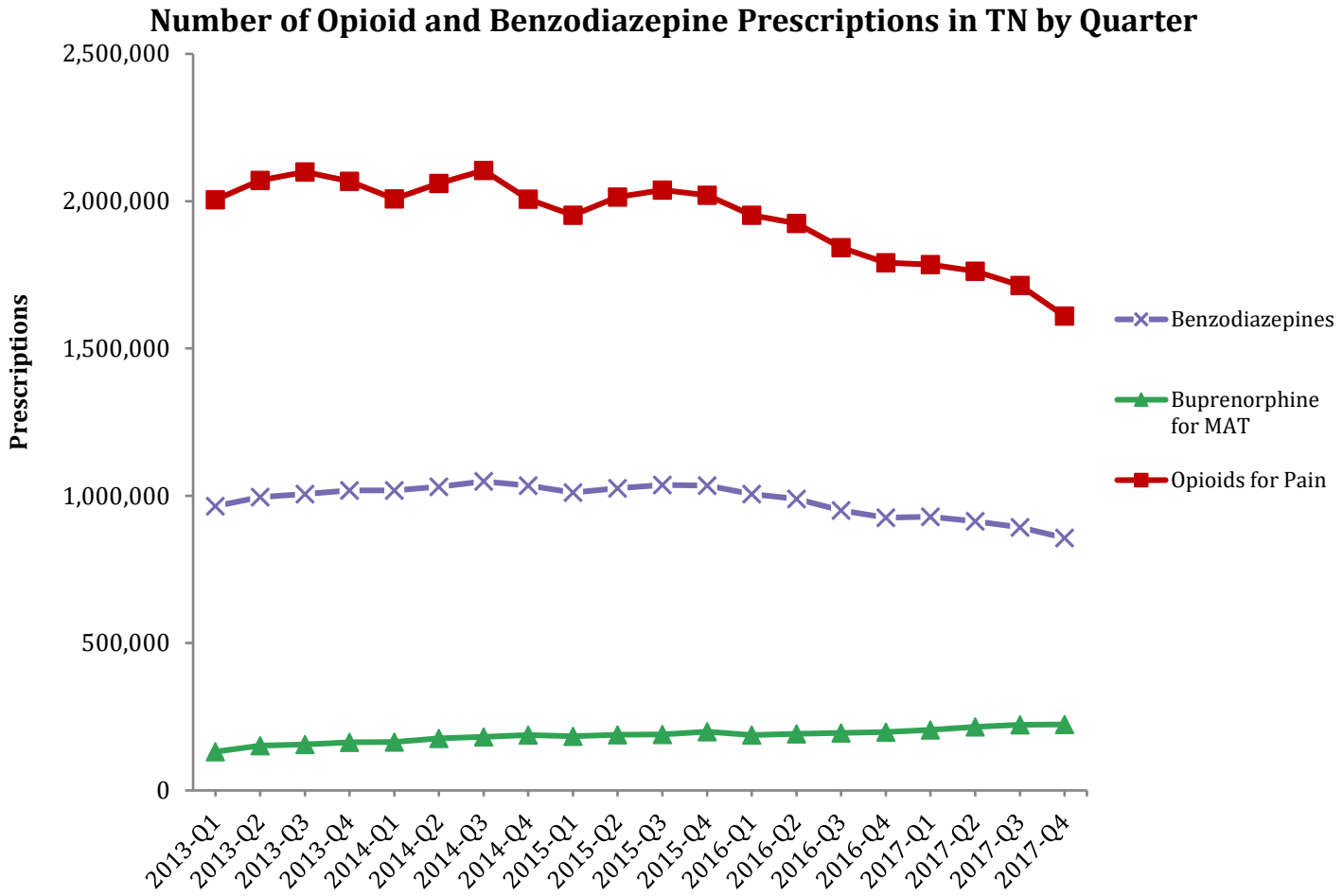
[1] https://www.tn.gov/health/health-program-areas/health-professional-boards/csmd-board/csmd-board/faq.html; Tennessee Chronic Pain Guidelines: Clinical Practice Guidelines for Outpatient Management of Chronic Non-Malignant Pain. January 2017.
[2] Tennessee Controlled Substance Monitoring Database Data Collection Manual: https://www.tn.gov/content/dam/tn/health/documents/TNDataCollectionManual.pdf
[3] See Technical Notes in Appendix C for additional methods details for prescription-related risk measures.
[4] National Center for Injury Prevention and Control. CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem, and opioid analgesics with oral morphine milligram equivalent conversion factors. Atlanta, GA: CDC (September 2017) http://www.pdmpassist.org/pdf/BJA_performance_measure_aid_MME_conversion.pdf
[5] CDC's Opioid Overdose Indicator Support Toolkit. Version 2.0. Release Date: 3/1/2017.

available indicators and **Appendix C** technical notes for additional information about indicator calculations).

There are a few limitations inherent with the CSMD data. First, information on opioid treatment data is incomplete as federally-funded treatment centers that dispense opioids for medication-assisted treatment do not report to the CSMD.[6] However, buprenorphine used for medication-assisted treatment prescribed in an outpatient setting is reported to the CSMD. Second, information on indication of use or medical history is not included in the CSMD. Thus, when calculating opioid indicators used for pain or medication-assisted treatment, we must rely on the FDA-label indication. Drug information is only as complete as the CDC classification tables which exclude many schedule V drugs and opioids primarily given in inpatient settings. We have done extensive work to provide additional information for drugs not included in the current CDC tables, but some information remains missing. Finally, the CSMD only tracks prescriptions that have been filled by a dispenser, not those written but never filled, and it is not a reliable indicator of drug use. Patients may fill prescriptions and never use them, or they may acquire prescription medications through illicit means. Despite these limitations, the CSMD does provide important information on prescribing practices and provides a good estimate of the overall amount of controlled substances available in TN.

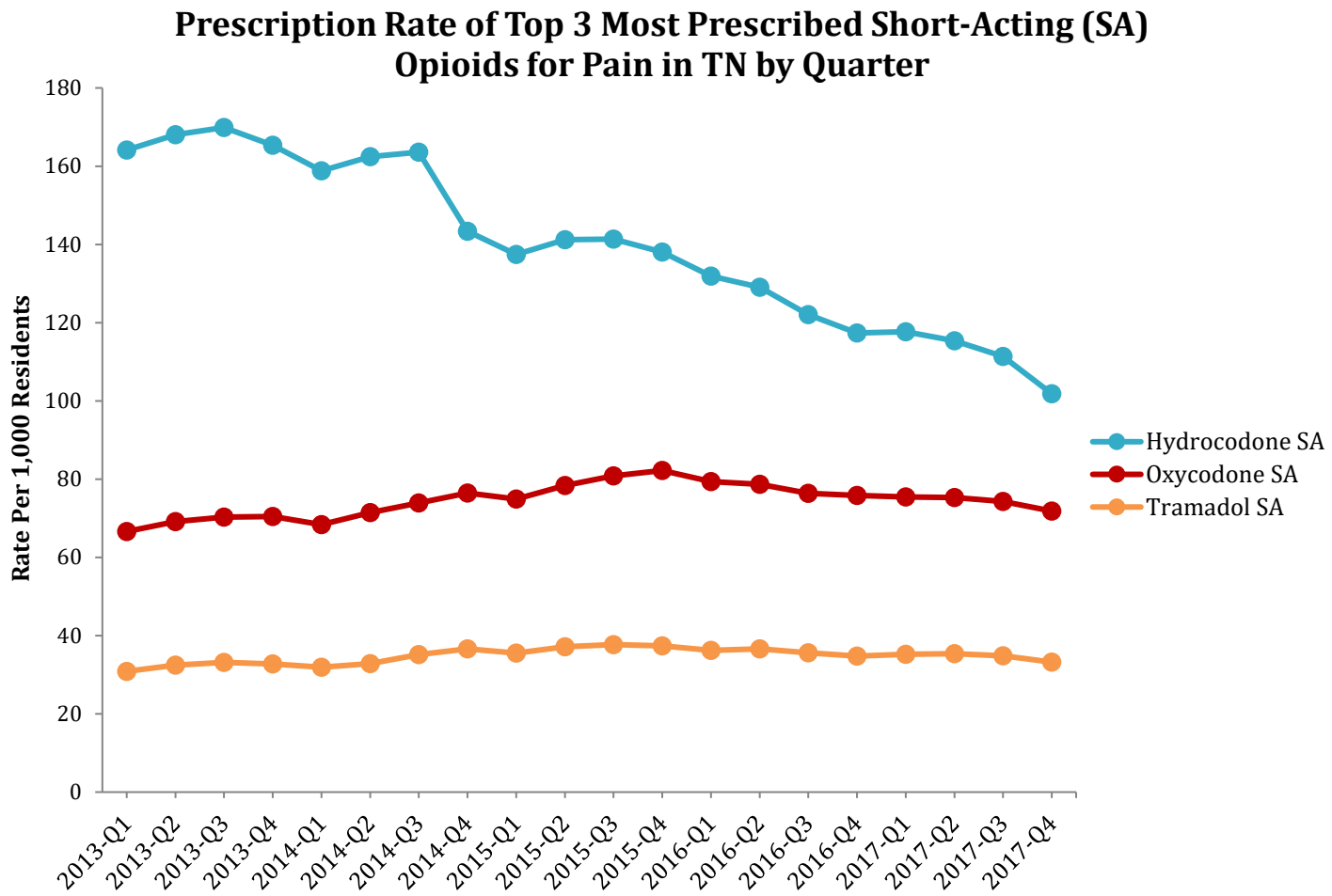
[6] Tennessee Chronic Pain Guidelines: Clinical Practice Guidelines for Outpatient Management of Chronic Non-Malignant Pain. January 2017; TN Code § 53-10-304 (2016)

## Opioid and Benzodiazepine Prescription Data




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

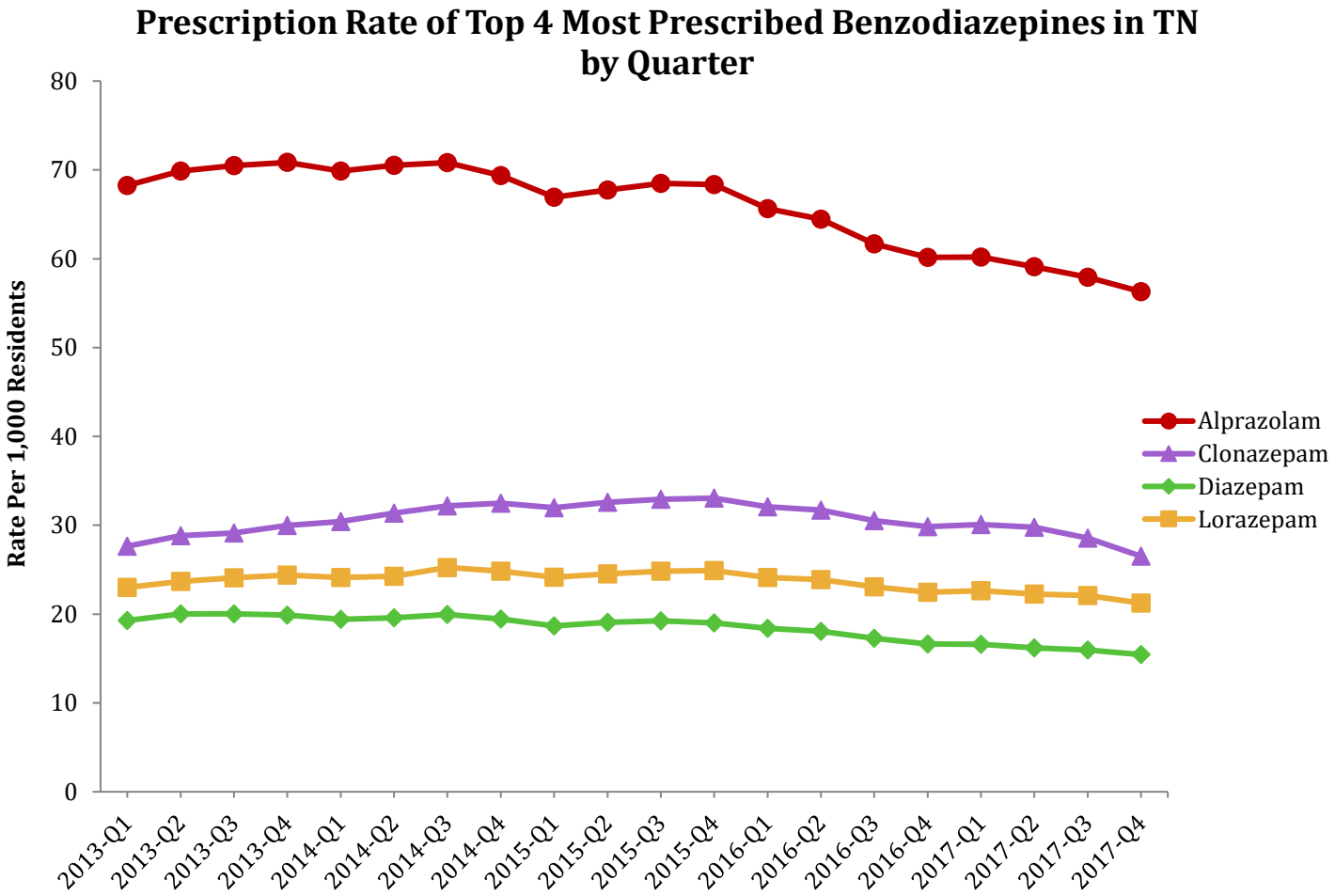
The number of opioid prescriptions for pain has declined between 2013 and 2017. From 2013 through 2015, opioid prescriptions numbered around 2 million a quarter (which represents a crude rate around 300-325 prescriptions per 1,000 residents) with some slight seasonal variation. After Q3 2015, opioid prescriptions for pain have declined in each quarter, down to just over 1.6 million (242.1 per 1,000 residents). Although only prescribed about half as often, benzodiazepine prescriptions have followed a similar trend, decreasing steadily from late 2015 through 2017, from a high of over 1 million prescriptions (157.1 per 1,000) down to about 860,000 at the end of 2017 (128.9 per 1,000). Concurrently, prescriptions filled for buprenorphine for medication assisted treatment have increased across nearly every quarter from approximately 130,000 prescriptions in Q1 2013 (20.3 per 1,000) to over 220,000 in Q4 2017 (33.7 per 1,000).




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The 3 most commonly prescribed short-acting (SA) opioids for pain in TN are hydrocodone, oxycodone, and tramadol, respectively, and they account for about 85% of all opioid prescriptions for pain in TN. Hydrocodone prescribing rates[7] have dropped steadily for most of the period from a high of 169.9 hydrocodone prescriptions per 1,000 TN residents in Q3 2013 to a low of 101.8 prescriptions per 1,000 in Q4 2017. The large decrease in hydrocodone prescribing from Q3 to Q4 in 2014 corresponds to the DEA's rescheduling of hydrocodone from a schedule III to a schedule II controlled substance beginning October 2014. Prescription rates for oxycodone increased from 66.6 per 1,000 in Q1 2013 to 82.2 per 1,000 in Q4 2015 before declining to 71.8 in Q4 2017. Tramadol followed a similar pattern, increasing from 30.9 per 1,000 in Q1 2013 to 37.7 per 1,000 in Q3 2015 before declining to 33.2 per 1,000 in Q4 2017.

[7] Rates without indication of "age-adjusted" are assumed to be crude rates in this report.

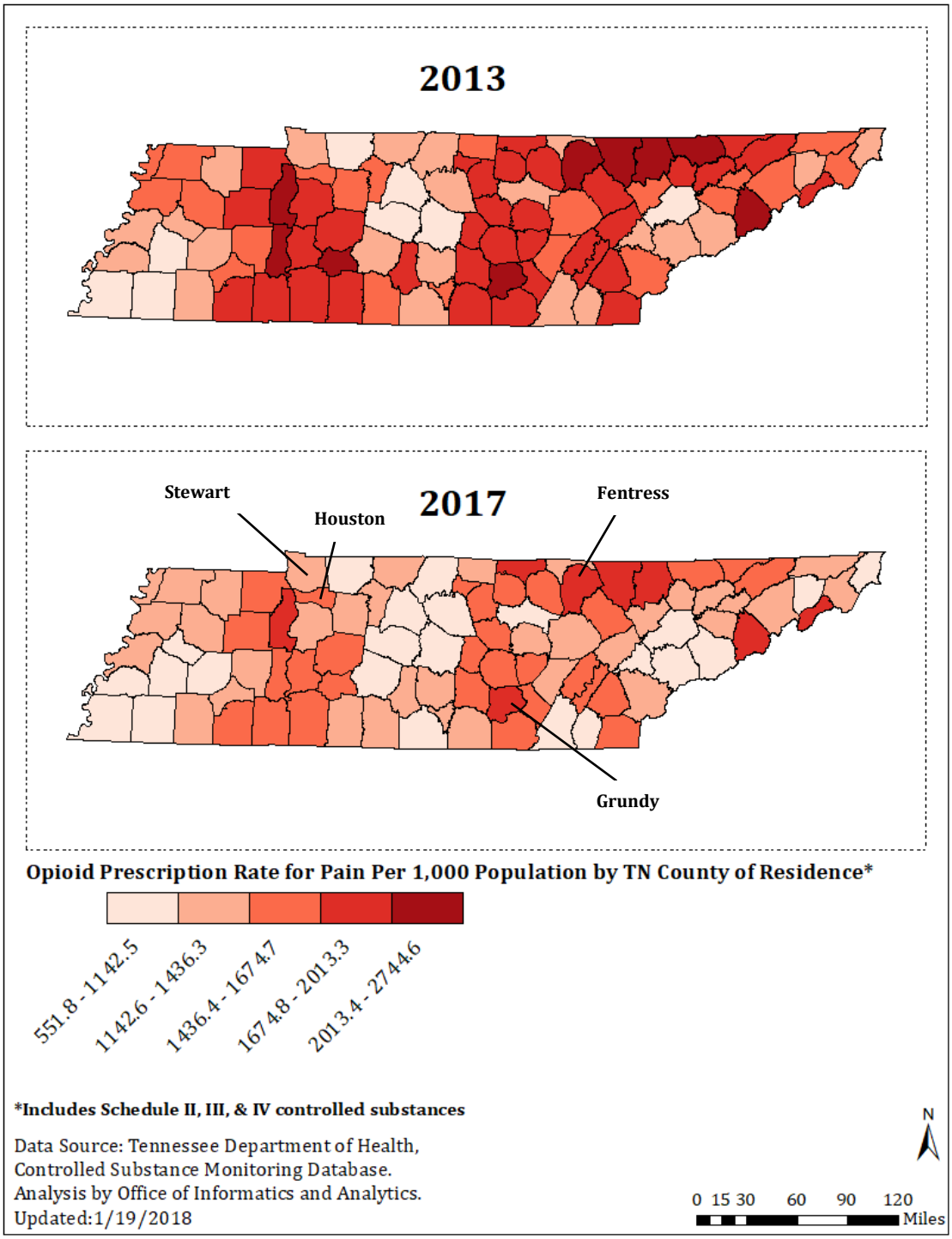



Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The top 4 most commonly prescribed benzodiazepines[8] in TN are alprazolam, clonazepam, lorazepam, and diazepam, respectively, and they account for over 90% of all benzodiazepine prescriptions filled each year. Alprazolam is prescribed at nearly 2 to 3 times the rate of the other most common benzodiazepines. After remaining steady around 70 prescriptions per 1,000 residents from 2013 through 2014, the prescription rate for alprazolam has decreased to 56.3 prescriptions per 1,000 in Q4 2017. The rate for clonazepam increased from 27.7 per 1,000 in Q1 2013 to 33.1 per 1,000 in Q4 2015 before decreasing to 26.5 per 1,000 in Q4 2017. The pattern for lorazepam was similar, increasing from 23.0 in Q1 2013 to 24.9 in Q4 2015 then declining to 21.2 in Q3 2017. Diazepam prescription rates remained fairly steady through 2015 around 19 per 1,000 before declining to 15.4 in Q3 2017.

[8] Common brand names for top prescribed benzodiazepines, alprazolam (Xanax), clonazepam (Klonopin), lorazepam (Ativan), and diazepam (Valium).

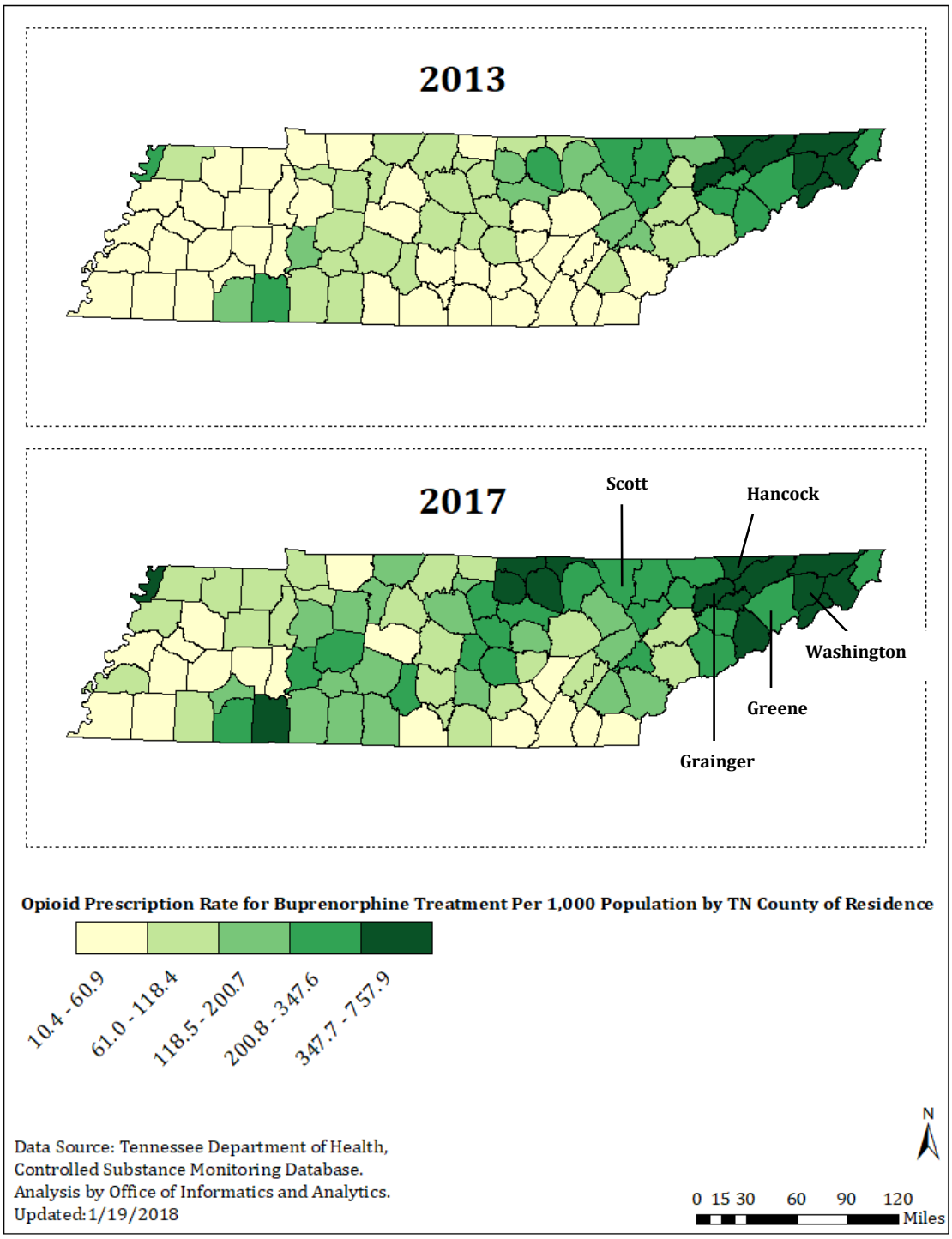
**Opioids for Pain Prescription Rate per 1,000 Residents by TN County, 2013 & 2017**




Prescription rates for opioids for pain per 1,000 TN residents were lower in 2017 compared to 2013 across counties, with the exception of Houston and Stewart.[9] Though the rates in Grundy and Fentress counties were less in 2017 (1986.1 and 1964.3, respectively) compared to 2013 (2744.6 and 2336.9, respectively), they remained among the highest in 2017.

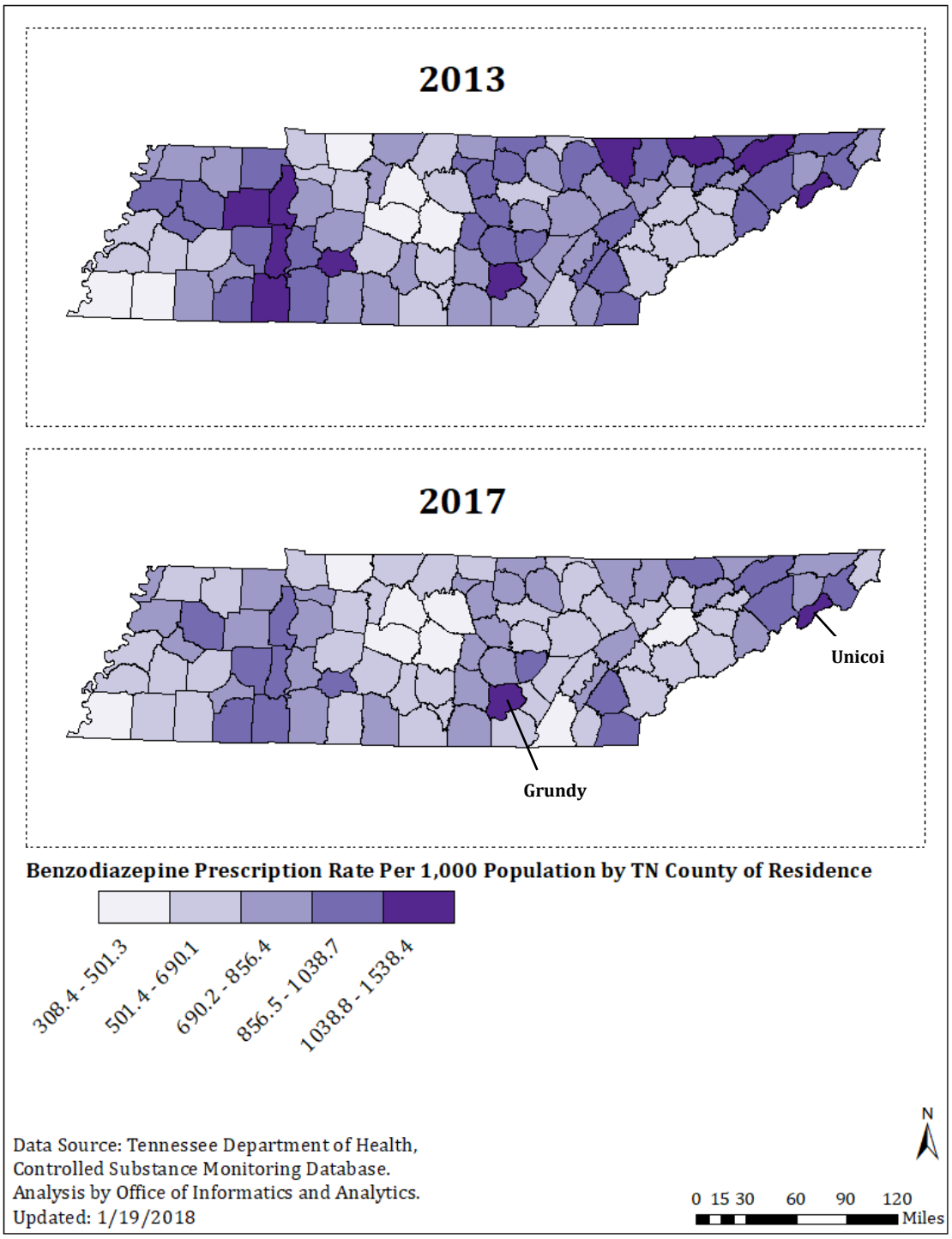
[9] See Appendix D1 for map with county and region names. Counts and rates for each county in TN are available on the TN Drug Overdose Dashboard: https://www.tn.gov/health/health-program-areas/pdo/pdo/data-dashboard.html

**Buprenorphine for MAT Prescription Rate per 1,000 Residents by TN County, 2013 & 2017**



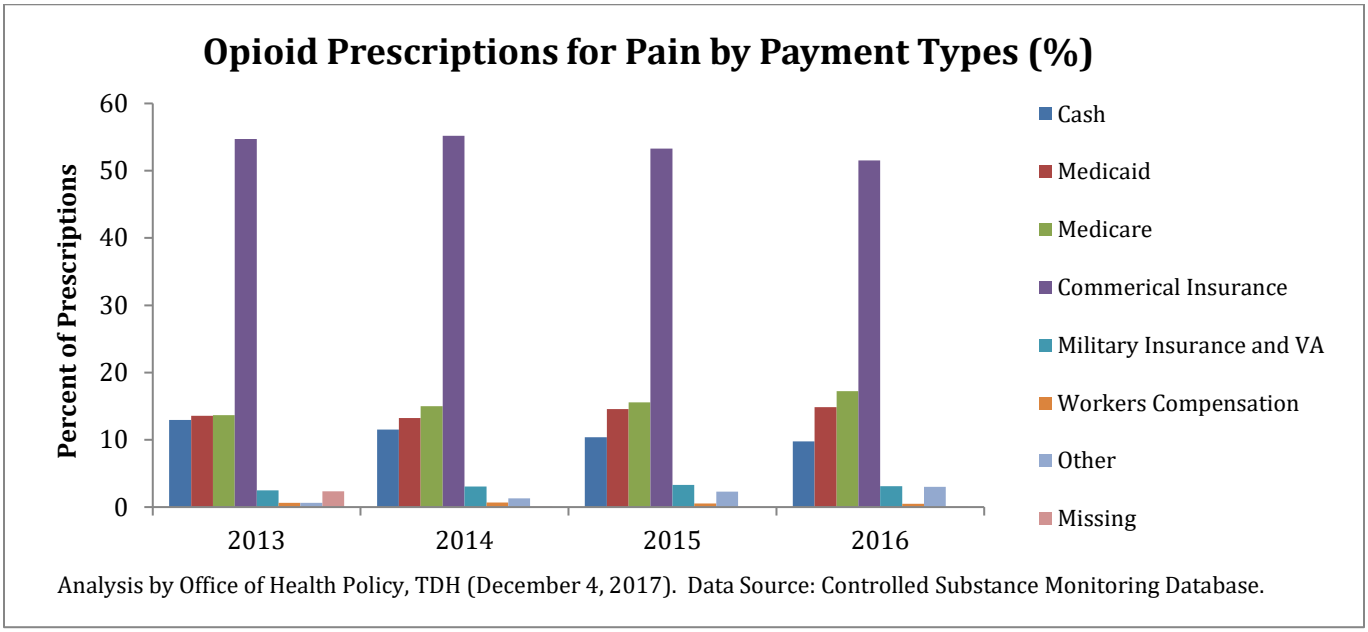

Prescription rates per 1,000 TN residents for buprenorphine medication-assisted treatment increased steadily from 2013 to 2017 across all counties except Hancock, Washington, Grainger, Scott, and Greene.

**Benzodiazepine Prescription Rate per 1,000 Residents by TN County, 2013 & 2017**



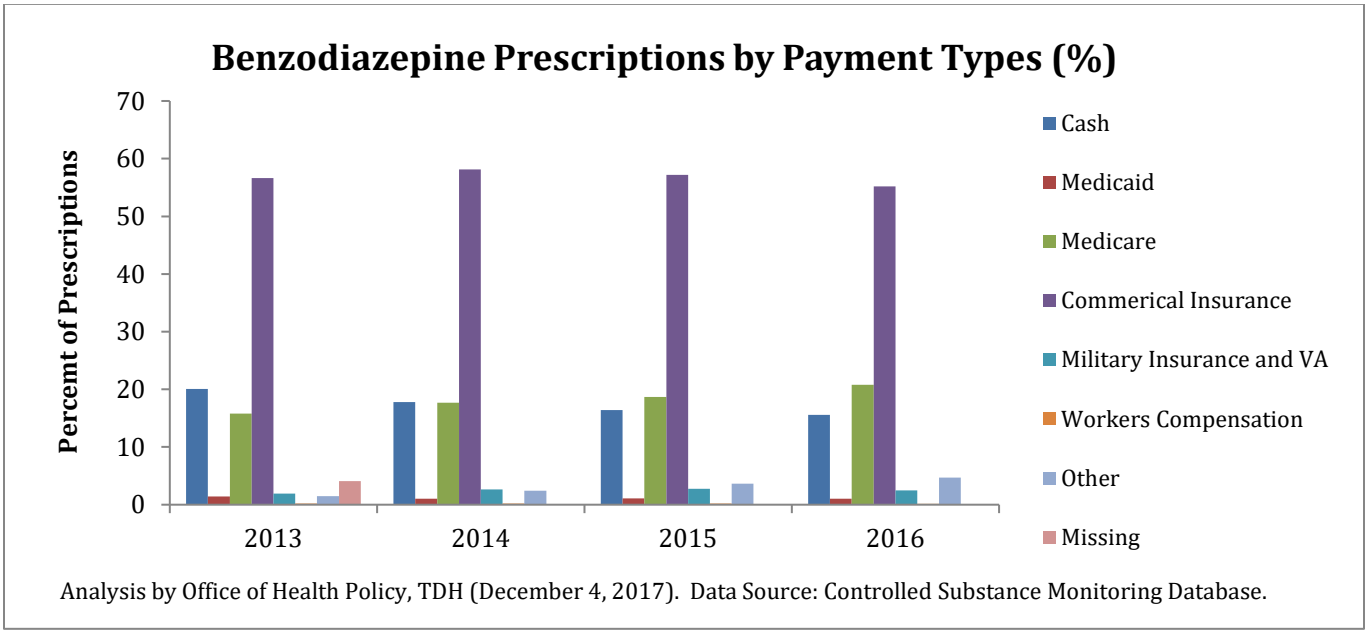

In 2017, the rates for benzodiazepine prescriptions were lower compared to 2013 in most counties. However, there were 8 counties with higher rates in 2017. Further, the 2017 rates per 1,000 TN residents for Unicoi (1169.4) and Grundy (1061.2) remained the two highest rates in the state.

## Payment Type for Opioid and Benzodiazepine Prescriptions




Analysis by Office of Health Policy, TDH (December 4, 2017). Data Source: Controlled Substance Monitoring Database.

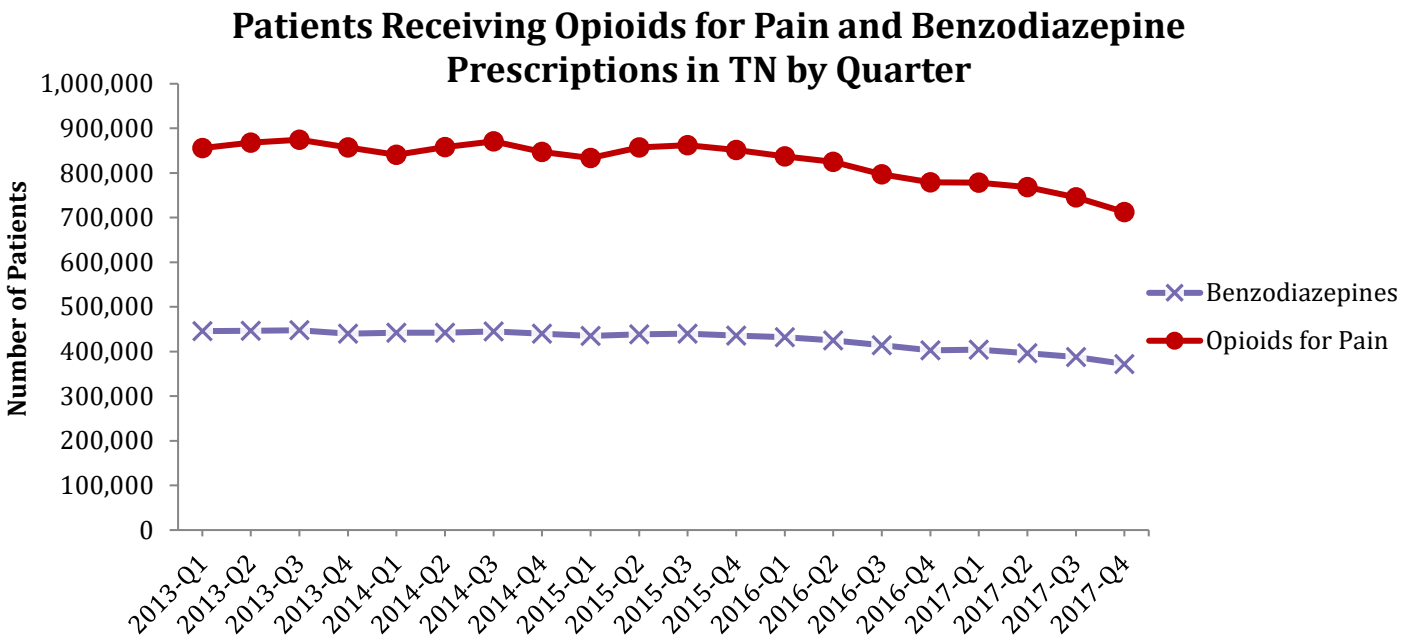
Among the top 4 payment types (commercial Insurance, Medicare, Medicaid, and Cash), increases were seen in opioid prescriptions paid for by Medicare (13.7% in 2013 to 17.3% in 2016) and Medicaid (13.6% in 2013 to 14.9% in 2013), while decreases were seen for opioid prescriptions paid for by commercial Insurance (54.7% in 2013 to 51.5% in 2016) and cash payment (13.0% in 2013 to 9.8% in 2016).




Analysis by Office of Health Policy, TDH (December 4, 2017). Data Source: Controlled Substance Monitoring Database.

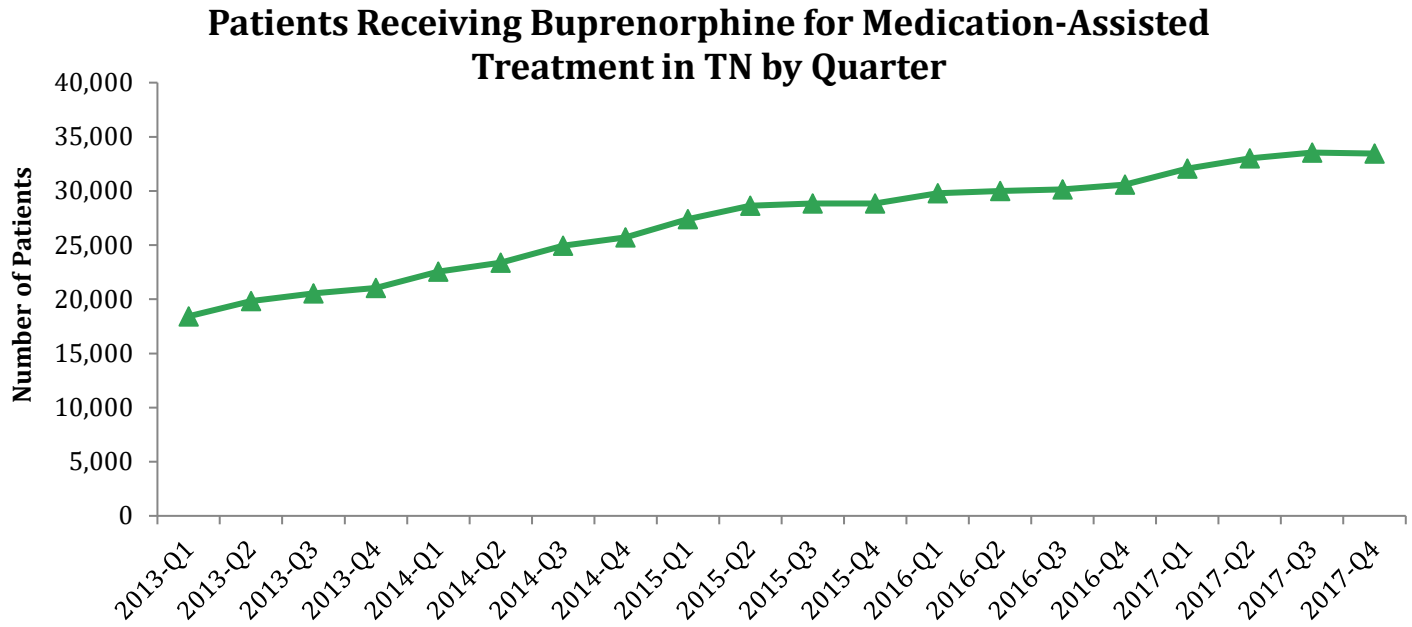
Among the top 3 payment types (commercial insurance, Medicare, and cash), increases were seen in benzodiazepine prescriptions paid for by Medicare (15.8% in 2013 to 20.8% in 2016), while decreases were seen for benzodiazepine prescriptions paid for with cash (20.1% in 2013 to 15.6% in 2016). Benzodiazepine prescriptions paid by commercial insurance increased from 56.6% in 2013 to 58.1% in 2014, and then decreased to 55.2% in 2016.

## Patient Prescription Data




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

In Q1 2013, 856,000 patients filled opioid prescriptions for pain, and by Q4 2017, that number was down to 713,000 patients. Similarly, patients filling benzodiazepine prescriptions declined from 446,000 in Q1 2013 to 372,000 in Q4 2017. The graph below shows the increase in number of patients filling prescriptions for buprenorphine for medication-assisted treatment. The number of patients filling buprenorphine prescriptions for medication-assisted treatment rose from 18,000 in Q1 2013 to 33,000 in Q4 2017.




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

## Active Prescription Days

Patients with opioid prescriptions for pain filled an average of just over 2 prescriptions per quarter. This trend was nearly identical for benzodiazepines and both rates have remained fairly stable from 2013 through 2017 (not shown). Patients using buprenorphine for medication-assisted treatment fill an average of 6 or 7 prescriptions in each quarter, with only a slight decrease across this time period.

The table below shows the yearly mean and median days that patients on opioids for pain or buprenorphine for medication-assisted treatment had an active prescription. This table demonstrates how much longer the average buprenorphine patient is in treatment compared to the average opioid for pain patient. Each year, half of the patients who were prescribed opioids for pain had active prescriptions for about a week or less. The average number of prescription days for opioids for pain is just over two months. Median active prescription days for buprenorphine are nearly four months or more each year and mean active prescription days are five months or greater.

**Active Opioid Prescription Days by Year for Patients in TN**

| Opioids for Pain | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| Median | 9 | 9 | 9 | 8 | 8 |
| Mean | 66.9 | 68.1 | 68.4 | 67.9 | 67.8 |
| **Buprenorphine for MAT** | **2013** | **2014** | **2015** | **2016** | **2017** |
| Median | 118 | 136 | 136 | 139 | 159 |
| Mean | 149.3 | 160.9 | 160.9 | 163.9 | 174.1 |

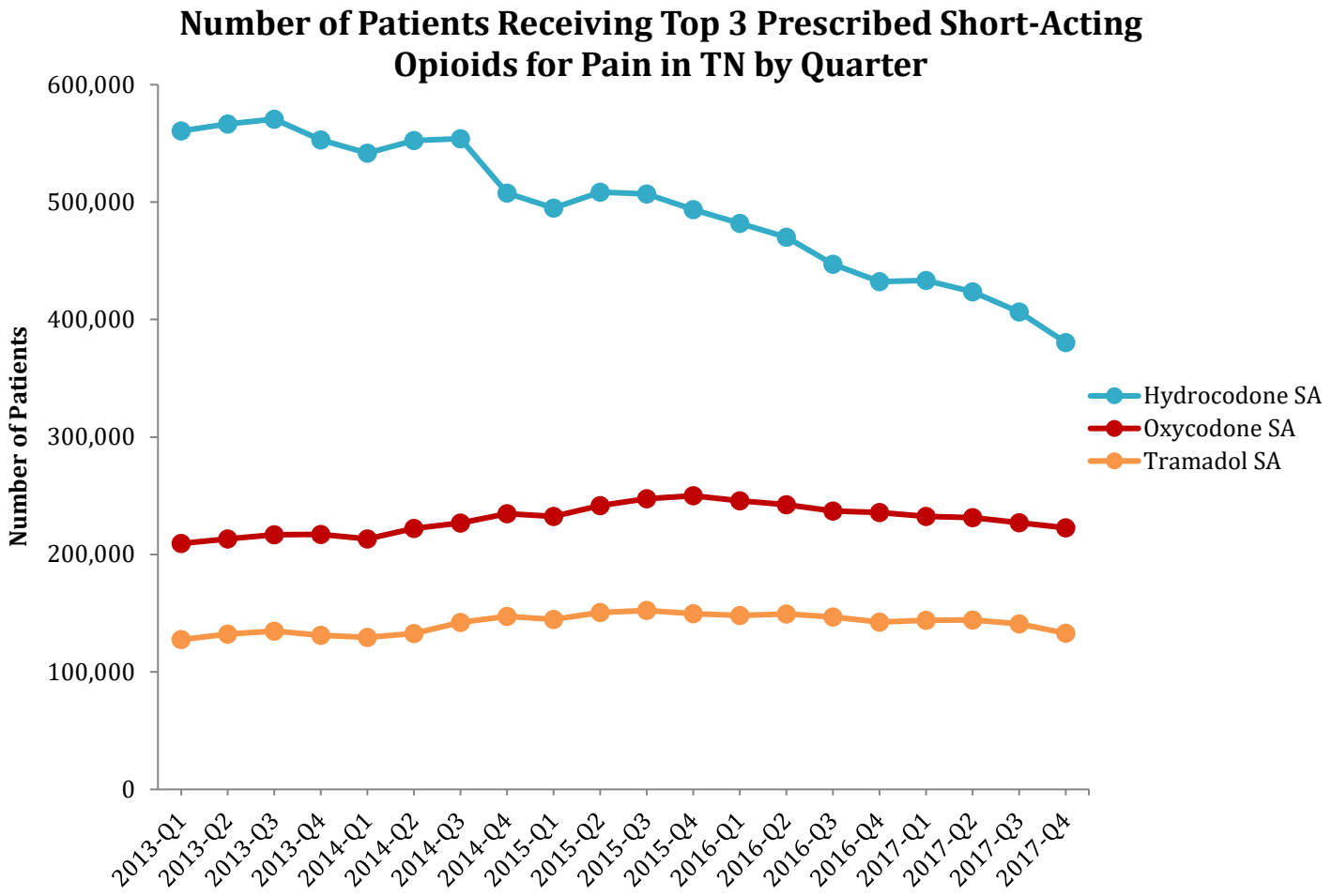
Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents.
Data Source: Controlled Substance Monitoring Database.

Each year, nearly 70% of patients who fill opioid prescriptions for pain have active prescriptions for 30 days or less throughout the year. Longer-term use is less common, however, about 12% of patients each year have active prescriptions for > three quarters of the year.

**Active Prescription Days for Patients Prescribed Opioids for Pain in TN**

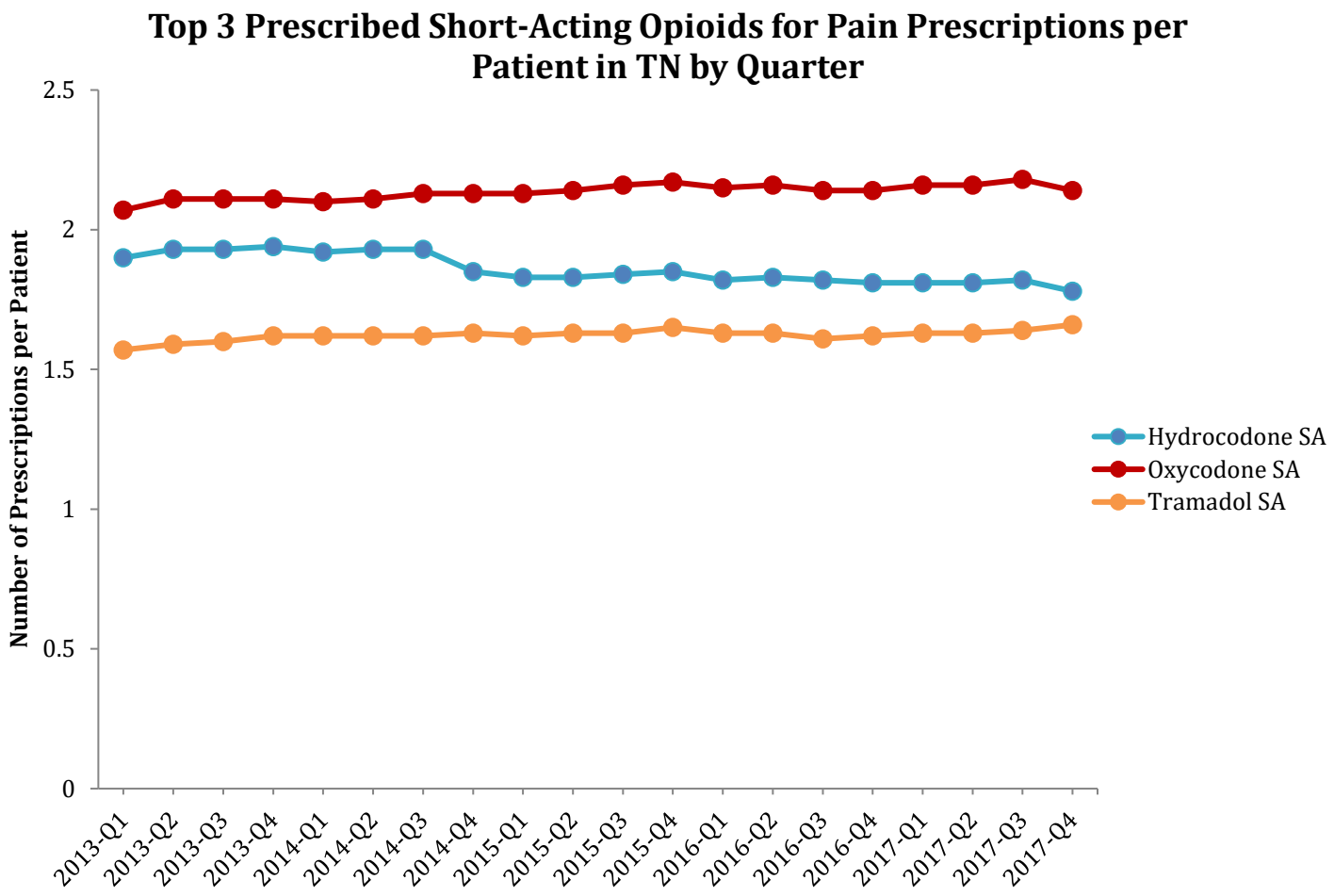
| Days | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| 1-7 days, % | 46.6 | 46.4 | 46.8 | 47.6 | 49.0 |
| 8-30 days, % | 21.9 | 22.1 | 22.1 | 21.6 | 20.9 |
| 31-90 days, % | 9.5 | 9.5 | 9.2 | 8.9 | 8.5 |
| 91-180 days, % | 5.9 | 5.7 | 5.5 | 5.4 | 5.1 |
| 181-270 days, % | 4.7 | 4.4 | 4.1 | 4.2 | 3.9 |
| > 270 days, % | 11.5 | 12.0 | 12.3 | 12.2 | 12.5 |

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.



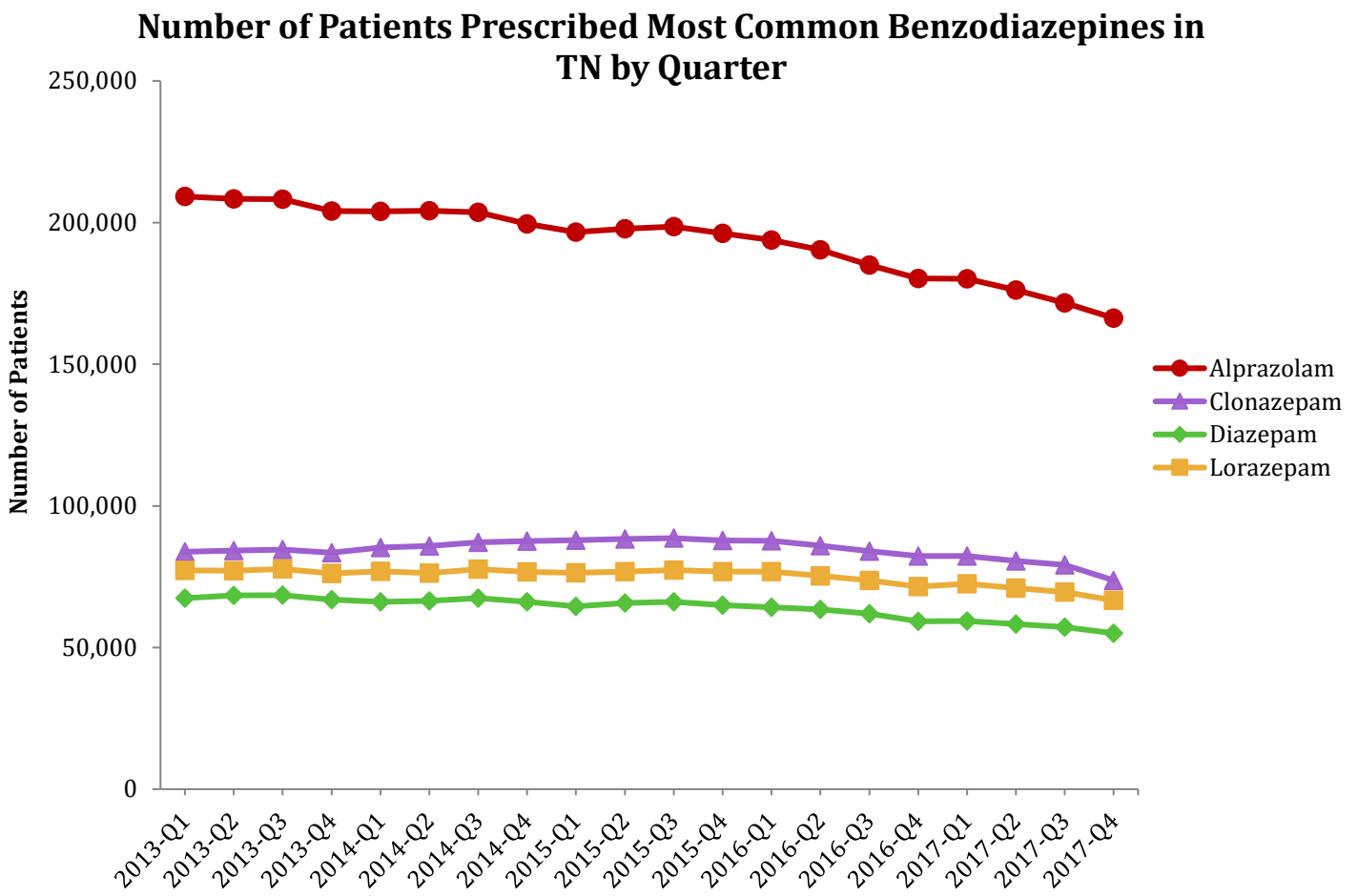

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The number of patients filling prescriptions for short-acting (SA) hydrocodone declined from 560,000 in Q1 2013 to 380,000 in Q4 2017. There was a sharp decline of nearly 50,000 hydrocodone patients that occurred after rescheduling of hydrocodone from a schedule III to a schedule II controlled substance in October 2014. Patients filling oxycodone prescriptions increased from 209,000 in Q1 2013 to 250,000 in 2015 Q4 then decreased to 220,000 in Q4 2017. Tramadol patients increased from 128,000 in Q1 2013 to over 150,000 in Q3 2015, with a decrease in Q4 2017 to 133,000.



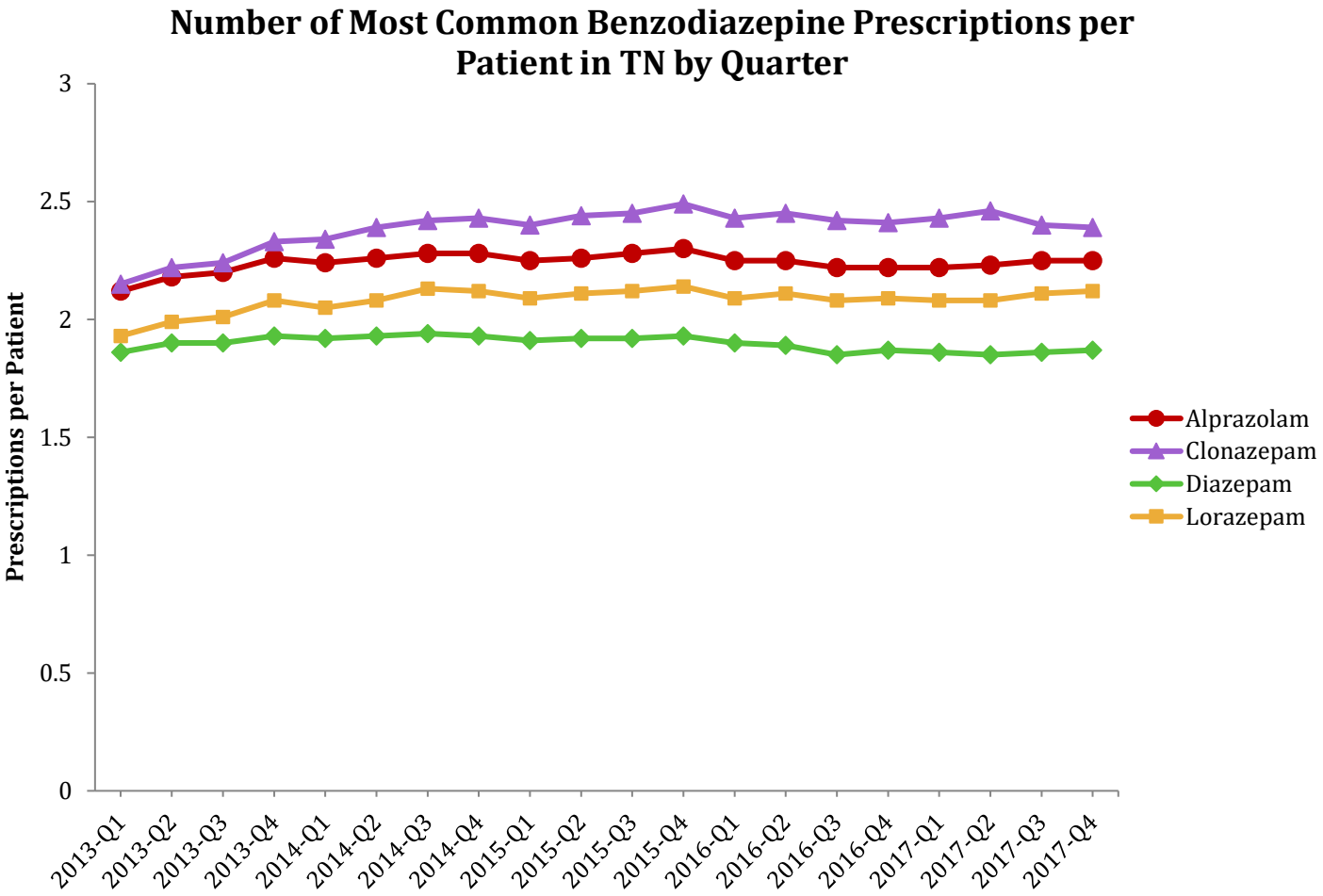

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

Although hydrocodone is the most prescribed opioid for pain in TN, more prescriptions are filled per patient, on average, for oxycodone, at a rate that has remained fairly steady (~2 prescriptions per patient). Patients fill an average of just under 2 prescriptions for hydrocodone per quarter, again with a decline in Q4 2014 associated with the rescheduling of hydrocodone from schedule III to schedule II. Tramadol patients filled an average of just over 1.5 tramadol prescriptions in each quarter, at a rate that remained fairly steady over time.



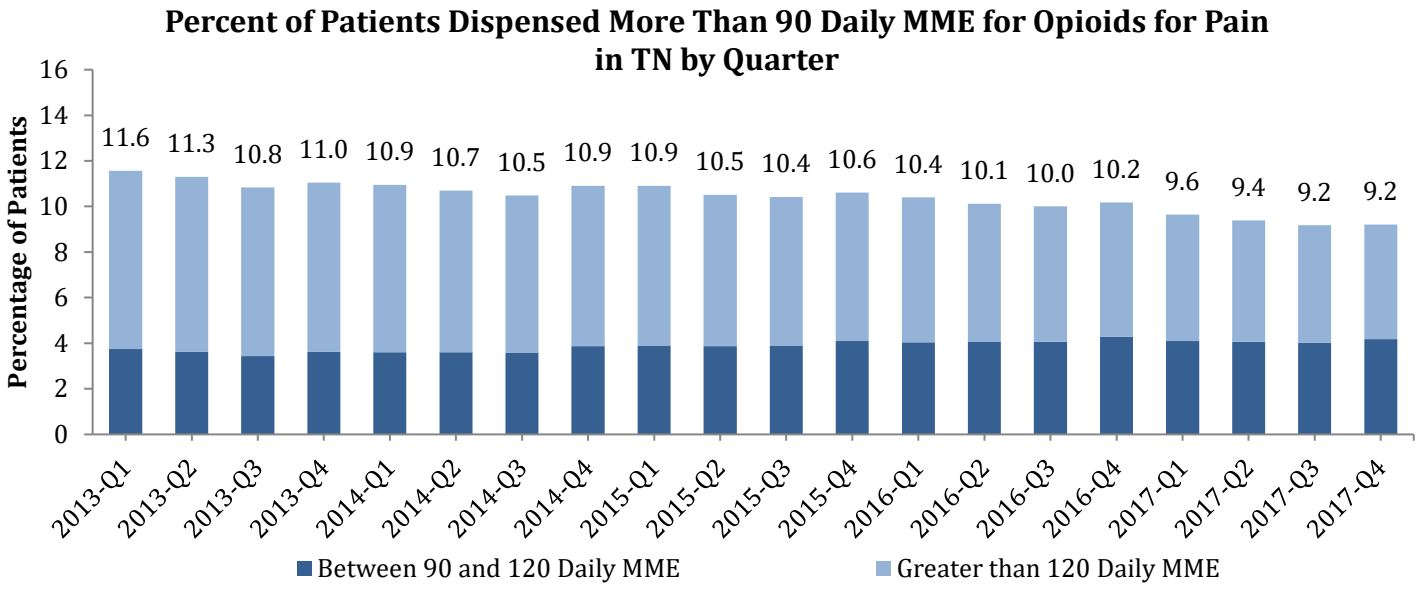

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The number of patients filling benzodiazepine prescriptions generally declined from the beginning of 2013 through 2017. The number of patients filling alprazolam prescriptions, the most common type of benzodiazepine, fell from 209,000 to 166,000 during this time. The number of patients filling clonazepam, diazepam, and lorazepam prescriptions was mostly steady from 2013 to late 2015 before declining through the end of 2017.



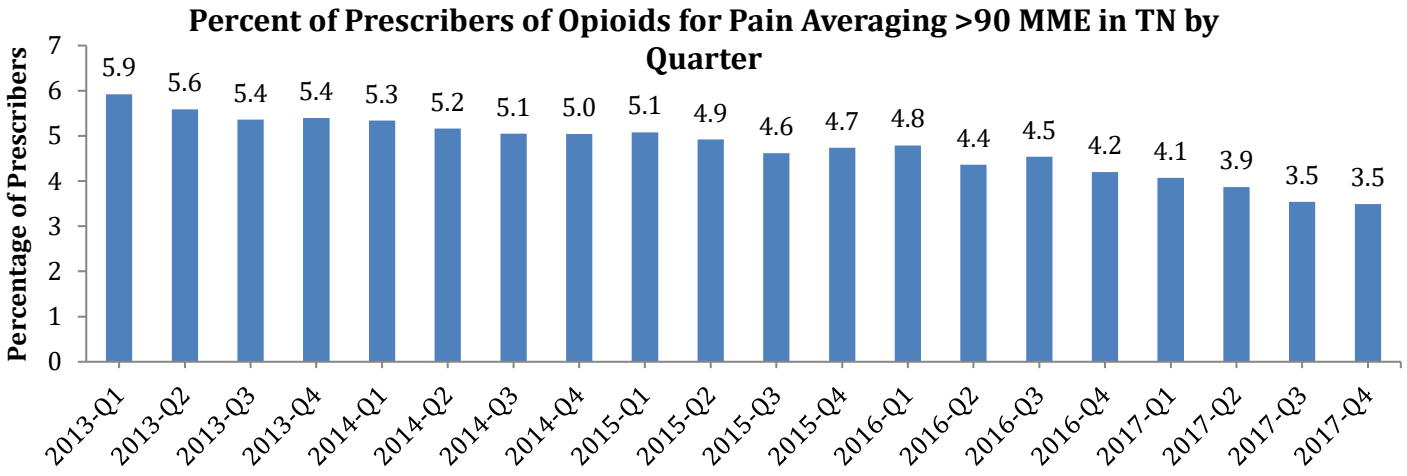

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The number of benzodiazepine prescriptions filled per patient in each quarter increased slightly through 2015 and then remained relatively steady for each type of benzodiazepine. Although alprazolam is the most commonly prescribed benzodiazepine in TN, clonazepam prescriptions per patient were higher from 2013 through 2017. Clonazepam patients filled slightly more prescriptions in each quarter, followed by alprazolam, lorazepam, and diazepam, respectively.



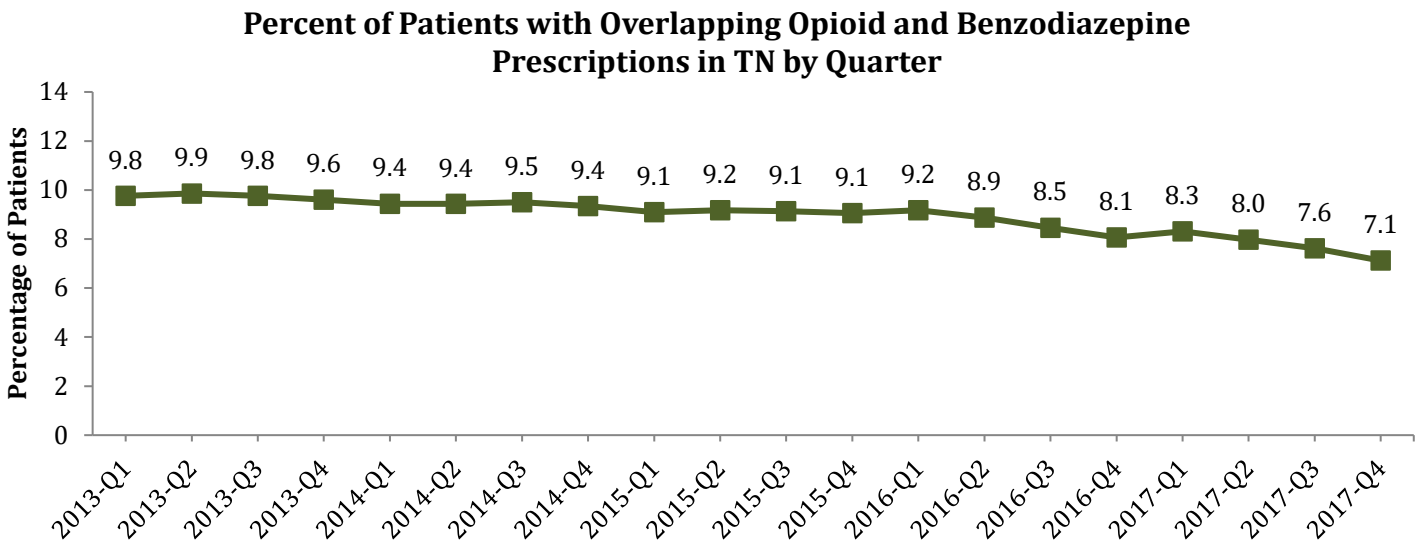

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The number of patients filling opioid prescriptions for pain > 90 daily morphine milligram equivalents (MME) has decreased from 2013 through 2017. This decrease primarily occurred among patients who have received prescriptions for greater than 120 daily MME. These patients once made up about 8% of the opioid for pain patient population, but now only account for about 5%. The percentage of patients receiving between 90 and 120 daily MME has remained relatively stable around 4% during this period.



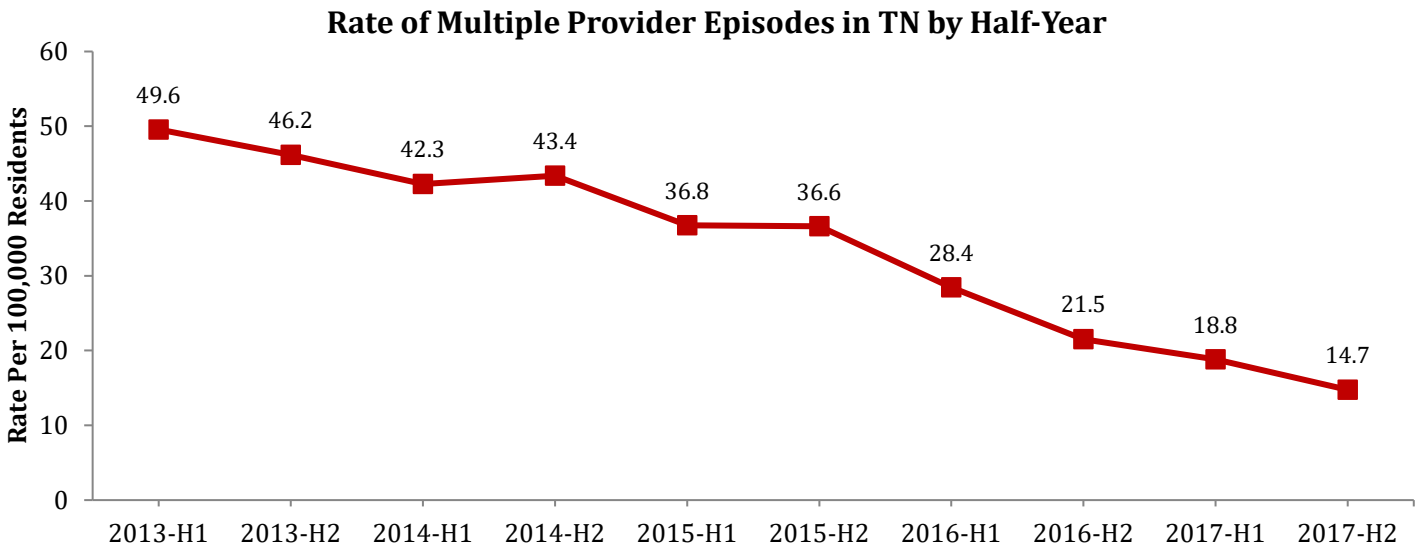

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

The graph above shows the percentage of prescribers of opioids for pain in each quarter who prescribed an average of > 90 daily MME for all prescriptions during that quarter. The percent of prescribers who average >90 MME has been steadily decreasing from 5.9% (1,649 prescribers) in early 2013 down to 3.5% (945 prescribers) at the end of 2017.




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents.Data Source: Controlled Substance Monitoring Database.

The percentage of patients filling opioid prescriptions for pain who have overlapping benzodiazepine prescriptions (>1 overlapping day) has decreased steadily from 9.8% in early 2013 to 7.1% in late 2017.




Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

According to the CDC definition,[10] a multiple provider episode (MPE) occurs when a patient fills prescriptions from at least 5 prescribers and at least 5 dispensers in a 6 month period (defined as the first or second half of the calendar year). In TN, the rate of MPEs has declined quickly from 49.6 per 100,000 residents in the first half of 2013 to 14.7 per 100,000 residents in the second half of 2017.

[10] CDC's Opioid Overdose Indicator Support Toolkit. Version 2.0. Release Date: 3/1/2017.

## Future Work

Our ultimate goal is to use sound scientific principles to put CSMD data to its best possible use in promoting and improving the health of Tennesseans. Linking data from the CSMD to other datasets with opioid-related health outcome data, such as death certificate and hospital discharge data is critical to maximize the use of TN's PDMP data. An important step in this process is properly identifying and linking patient records within the CSMD data and linking CSMD patients to vital records and hospitalization data. To this end, the analytics team has spent considerable time documenting the CSMD data and determining appropriate entity resolution and data linkage methods to accurately connect patients' prescription history with health outcome data. We continue to improve upon these methods to increase accuracy and are in the process of developing more sophisticated approaches that will enable consistent, reliable linkage between and within datasets for analytic and public health surveillance projects.

In addition to improving entity resolution, we continue to work on enhanced indicators of prescribing trends to inform policy and practice in TN. We are currently developing a number of additional indicators of patient-level prescription trends including: improved tracking of multiple provider episodes across varying periods of time, more comprehensive indicators of overlapping opioid and benzodiazepine prescriptions, and new metrics to identify chronic opioid and benzodiazepine users. In addition to public health surveillance, these indicators can be used to identify patients at risk of adverse outcomes to target for prevention and intervention.

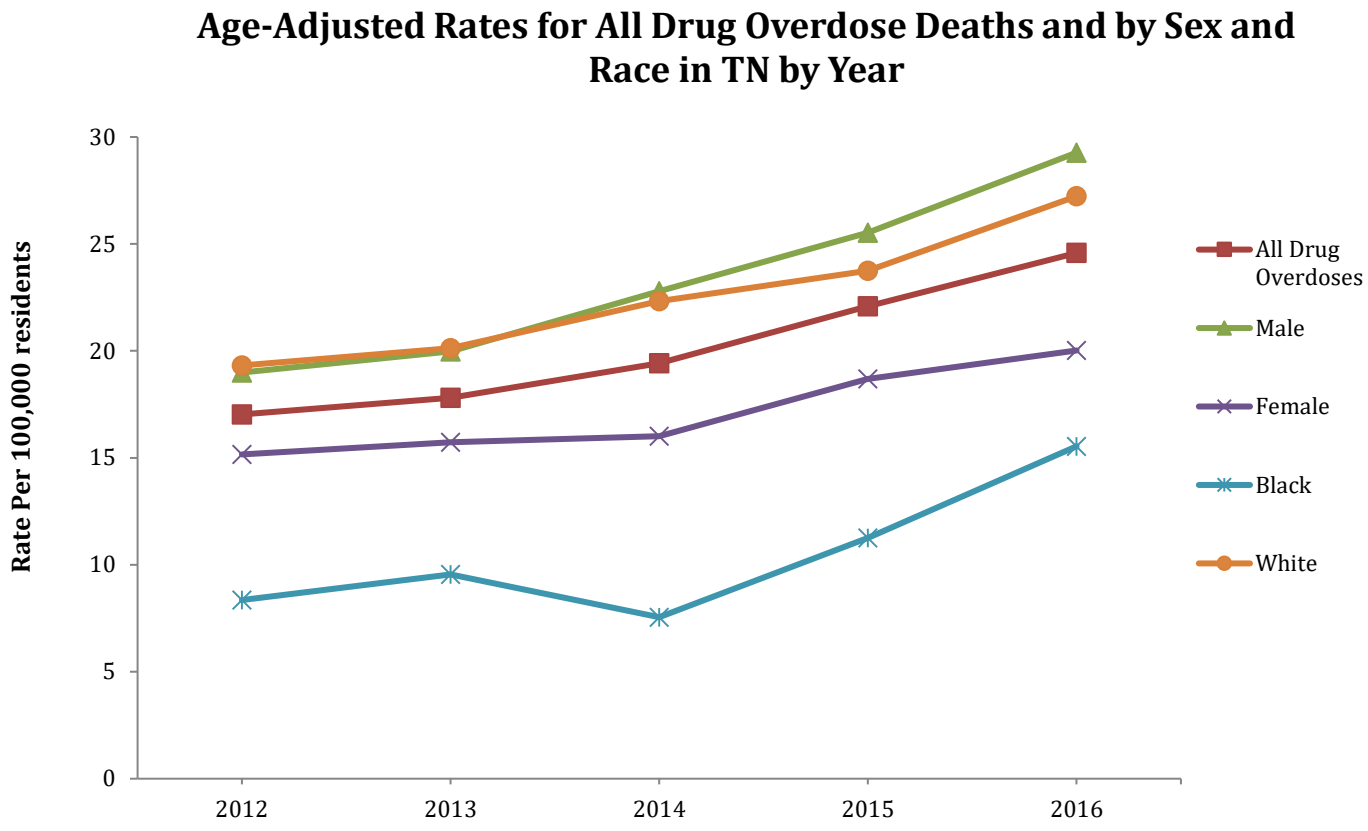
A major goal for OIA in 2018 is introducing prescriber-level indicators to identify high-risk prescribers, pursuant to TCA §68-1-128. We have been working closely with the Office of General Counsel to identify those prescribers whose controlled substance prescribing practices are associated with adverse patient outcomes such as overdose deaths, hospitalizations and chronic, high-MME opioid use. In 2018, we are developing a series of high risk indicators for a priori identification of prescribers with concerning prescription patterns. To date we have identified 8 potential indicators. In the first quarter of 2018, those will be validated, weighted, and a model developed to rank risk level, thus identifying in rank order practices of concern, See **Data-driven Support for Licensure and Over-prescribing Investigations** section for further information. This work requires appropriate identification of prescribers, specialties, practices and the patients they treat to properly identify prescribers for further investigation and/or education. Thus, in addition to patient entity management and data linkage, we have additional projects to improve prescriber identification and entity management (see **Appendix D** for summary on prescriber entity management).

# Drug Overdose Deaths in Tennessee, 2012-2016

## All Drug Overdose Deaths

All drug overdose deaths[11] continue to increase in TN with elevations observed regardless of sex and race. The total number of all drug overdose deaths by year were as follows: 1,094 (2012), 1,166 (2013), 1,263 (2014), 1,451 (2015), and 1,631 (2016). As shown in the below figure, the age-adjusted rate for all drug overdoses per 100,000 TN residents increased from 17.0 in 2012 to 24.6 in 2016.

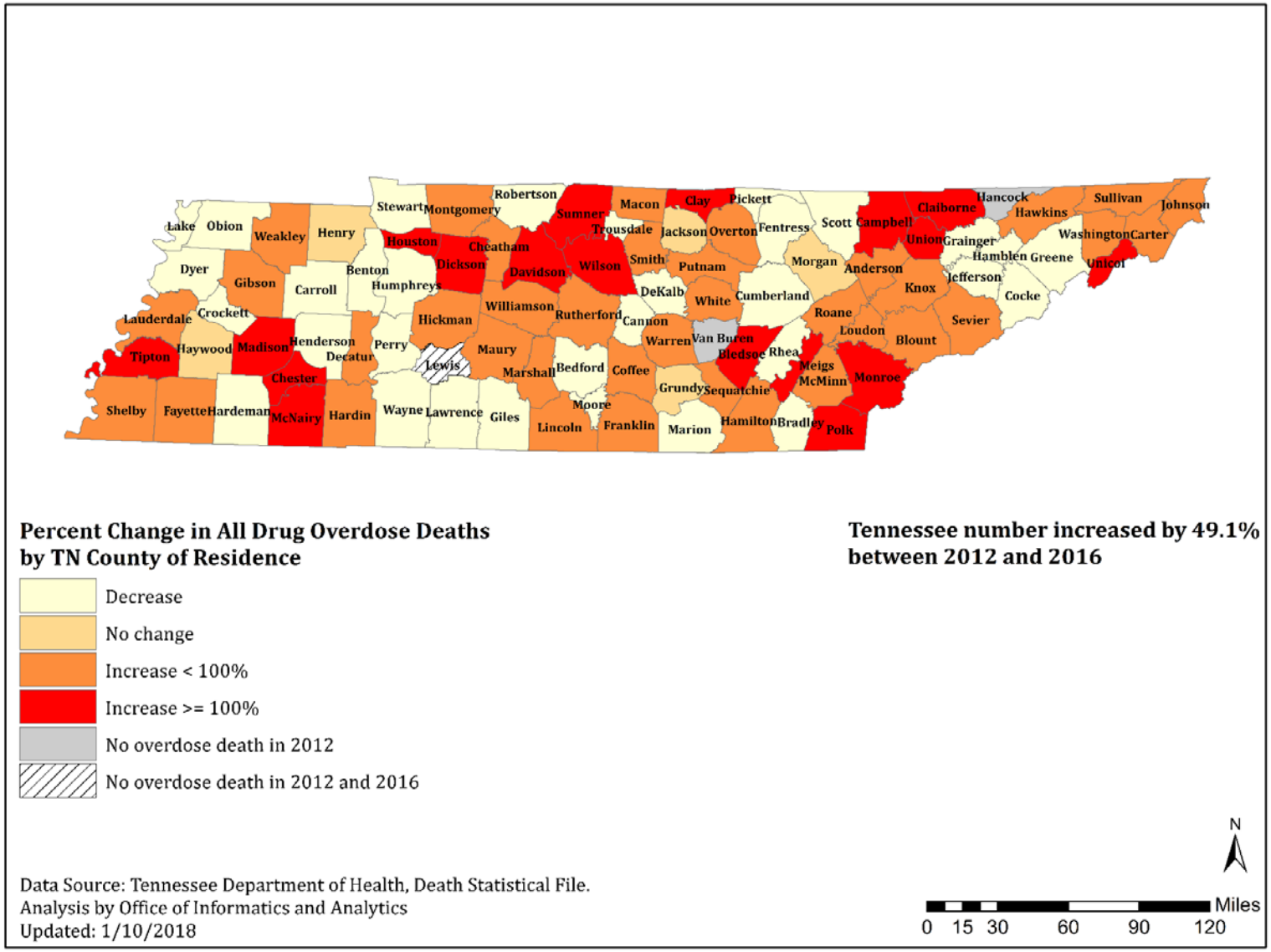
Rates increased for both males and females, as well as Blacks and Whites.[12] Highest rates were observed for males and Whites in 2016, with age-adjusted rates of 29.3 per 100,000 TN residents and 27.2 per 100,000 TN residents, respectively. Among Blacks, the age-adjusted rate increased from 8.4 per 100,000 TN residents in 2014 to 15.5 per 100,000 TN residents in 2016.



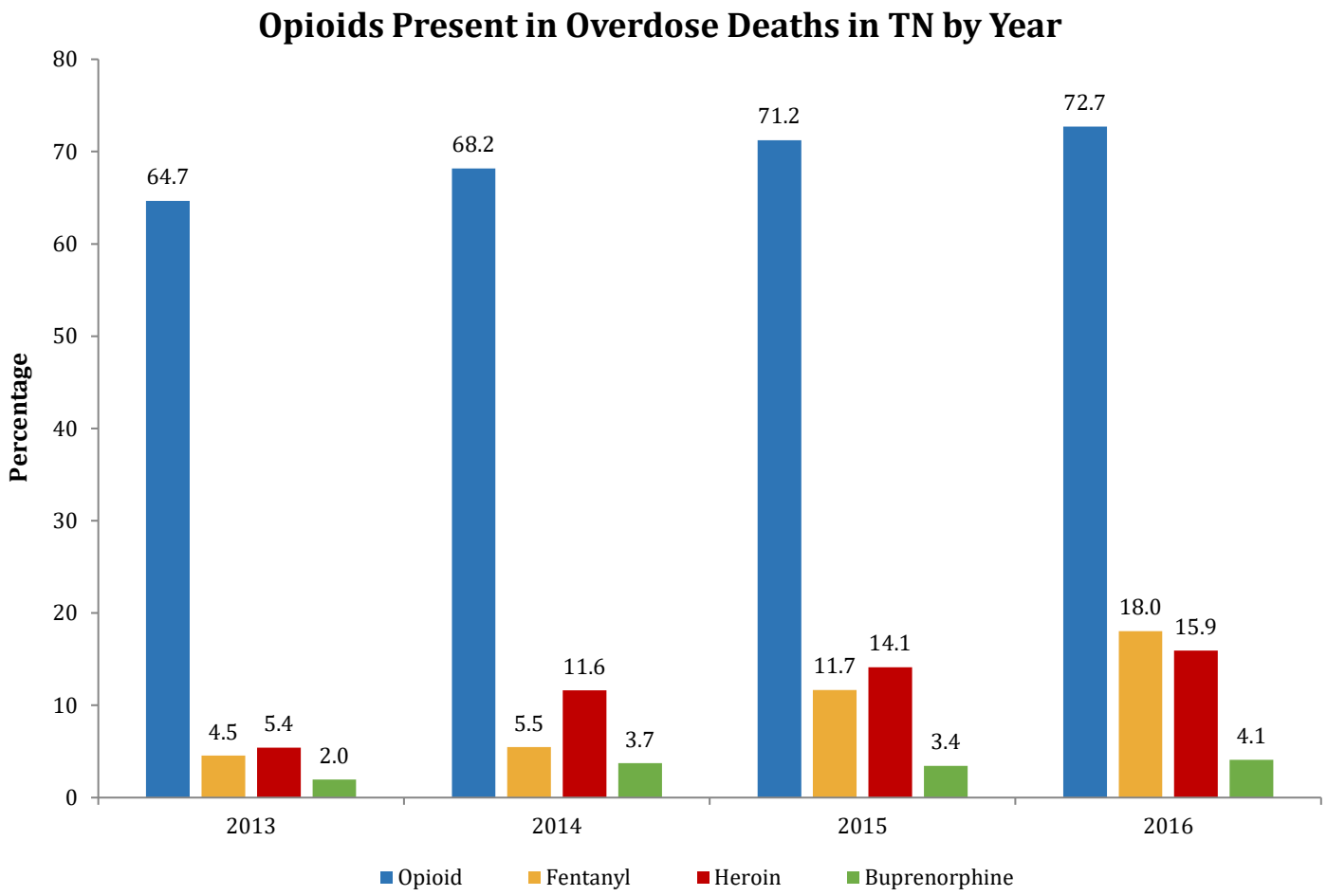

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data Source: TN Death Statistical File.

[11] Drug overdose deaths caused by acute poisonings, regardless of intent (i.e., unintentional, suicide, assault, or undetermined).
[12] Other races were excluded due to small samples sizes, which preclude calculation of reliable rates.

## Percent Change in Number of All Drug Overdose Deaths by TN County of Residence, 2012-2016[13]




[13] Rates by county were not calculated due to small sample sizes, which would result in unreliable rates. Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 overdose deaths to 197 is an absolute change of 67 overdose deaths, but only a percent change of 51.5%.

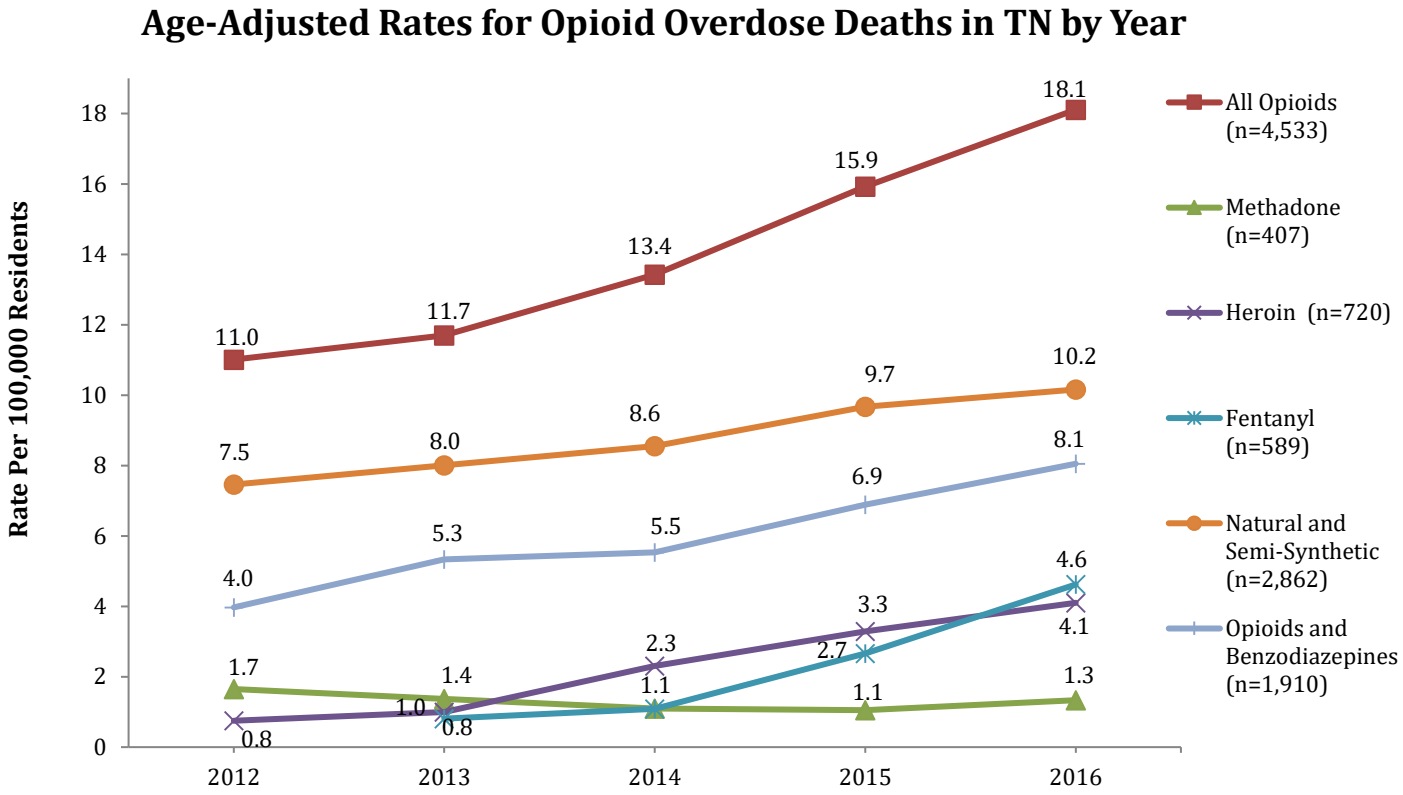



Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Percentages for fentanyl, heroin, buprenorphine are included in the opioid category and are broken out for clarity. Data source: TN Death Statistical File.

The above figure displays the proportion of all drug overdose deaths that involved opioids as a contributing substance. Categories are not mutually exclusive. During 2013 to 2016, the proportion of all drug overdose deaths involving any type of opioid increased from 64.7% to 72.7%. During 2013 to 2016, the proportion of all drug overdose deaths involving fentanyl increased from 4.5% to 18.0%, the proportion of all drug overdose deaths involving heroin increased from 5.4% to 15.9%, and the proportion of all drug overdose deaths involving buprenorphine increased from 2.0% to 4.1%.

## Opioid-Related Drug Overdose Deaths

The rate of all opioid overdose deaths[14] continued to increase in TN with an age-adjusted rate of 11.0 per 100,000 in 2012 and an age-adjusted rate of 18.1 per 100,000 in 2016. Natural and Semi-Synthetic prescription opioid death rates (excluding synthetic opioids such as fentanyl),[15] while on the rise since 2012, appeared to be increasing at a small rate (9.7 per 100,000 in 2015 and 10.2 per 100,000 in 2016). In contrast, substantial increases were observed for heroin[16] and fentanyl[17] since 2013.[18] Methadone[19] deaths were the only opioid overdose type with a decrease observed between 2012 (1.7 per 100,000) and 2016 (1.3 per 100,000). Deaths due to combined opioid (any type) and benzodiazepine[20] use continue to increase in TN.




Analysis by the Office of Informatics and Analytics, TDH (last updated, December 15, 2017). Limited to TN residents. Rates for counts <20 were considered unreliable and not calculated (i.e., fentanyl in 2012). Data Source: TN Death Statistical File.

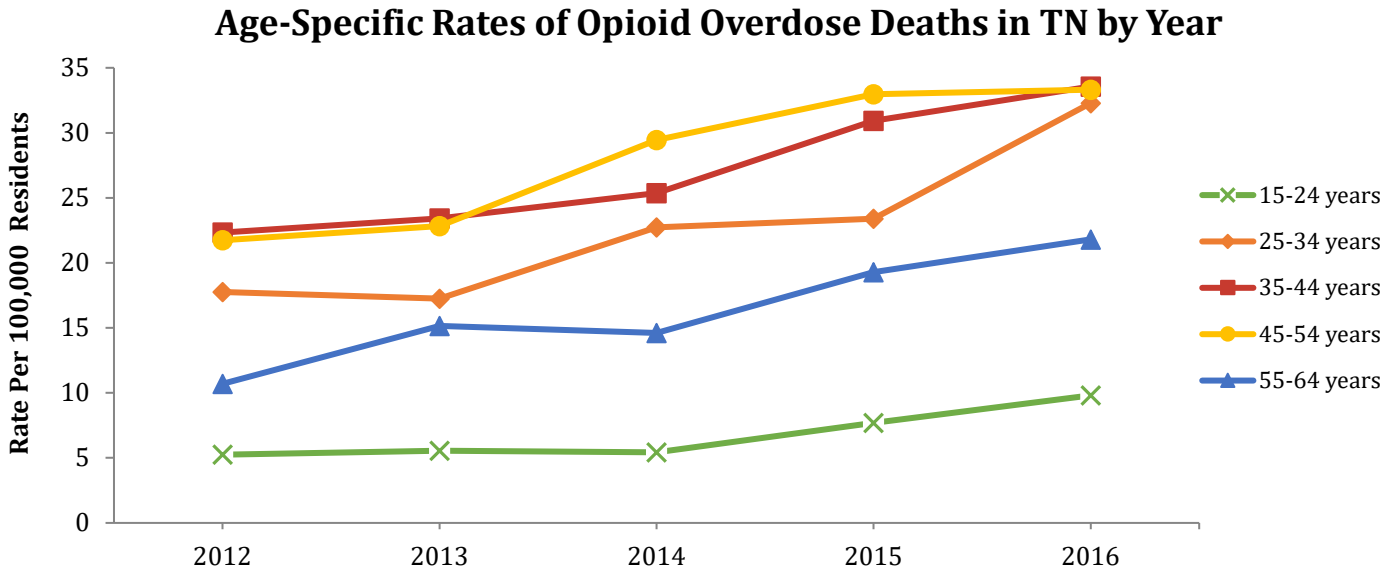
[14] Drug overdose deaths caused by acute poisonings that involve any opioid as a contributing cause of death.
[15] Drug overdose deaths caused by acute poisonings that involve natural and semi-synthetic opioids as a contributing cause of death (e.g., hydrocodone, oxycodone, morphine).
[16] Drug overdose deaths caused by acute poisonings that involve heroin as a contributing cause of death.
[17] Drug overdose deaths caused by acute poisonings that involve fentanyl.
[18] 2013 was the first year of available data on fentanyl overdoses and most likely is an underestimate based on death certificate data, see below section ***Epidemiology Methods: Using Death Certificate Data*** for more details
[19] Drug overdose deaths caused by acute poisonings that involve methadone as a contributing cause of death.
[20] Drug overdose deaths caused by acute poisonings that involve both an opioid and benzodiazepine as a contributing cause of death.

| Number of People Who Died of a Drug Overdose in Tennessee by Contributing Substance, 2013-2016 (n= 5,511) | | | | |
|---|---|---|---|---|
| | **2013** | **2014** | **2015** | **2016** |
| All Drug | 1,166 | 1,263 | 1,451 | 1,631 |
| Opioid | 754 | 861 | 1,034 | 1,186 |
| Prescription Opioids (Natural, semi-synthetic and synthetic)[21] | 637 | 697 | 848 | 1,009 |
| Pain Relievers (per CDC Definition, includes methadone)[22] | 578 | 603 | 689 | 739 |
| Natural and Semi-Synthetic Opioids | 516 | 553 | 639 | 679 |
| Heroin | 63 | 147 | 205 | 260 |
| Fentanyl[23] | 53 | 69 | 169 | 294 |
| Methadone | 86 | 71 | 67 | 82 |
| Benzodiazepine | 371 | 388 | 492 | 573 |
| Opioid and Benzodiazepine | 340 | 352 | 447 | 522 |
| Analysis by the Office of Informatics and Analytics, TDH (last updated, December 15, 2017). Data source: TN Death Statistical Files. | | | | |

The table above displays drug overdose death numbers from 2013 to 2016. The total number of all drug overdose deaths increased from 1,166 in 2013 to 1,631 in 2016. All opioid overdose deaths increased from 754 in 2013 to 1,186 in 2016, a percent increase of 57.3%. Heroin overdose deaths increased from 63 deaths in 2013 to 260 deaths in 2016, a percent increase over 300%. Fentanyl overdose deaths increased from 53 deaths in 2013 to 294 deaths in 2016, a percent increase of over 450%.

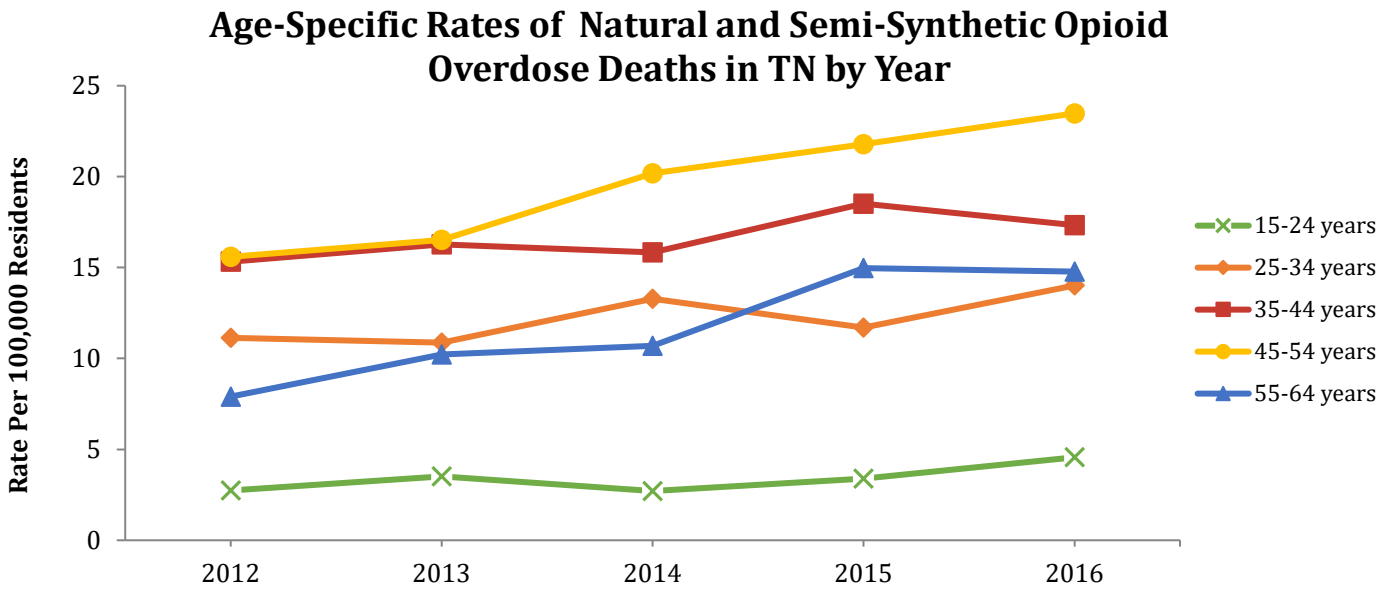
[21] Drug overdose deaths caused by acute poisonings that involve natural and semi-synthetic opioids as a contributing cause of death (e.g., hydrocodone, oxycodone, morphine).
[22] Drug overdose deaths caused by acute poisonings that involve natural and semi-synthetic opioids as a contributing cause of death (e.g., hydrocodone, oxycodone, morphine). Reference: CDC's Opioid Overdose Indicator Support Toolkit. Version 2.0. Release Date: 3/1/2017.
[23] 2013 was the first year of available data on fentanyl overdoses and most likely is an underestimate based on death certificate data, see below section ***Epidemiology Methods: Using Death Certificate Data*** for more details

The three graphs below display age-specific rates for specific types of opioid overdose deaths in TN. In the first graph, which focused on all opioid overdose deaths, persons aged 45-54 years and 35-44 years had the highest rates of overdose deaths, with the age group of 25-34 years approaching similarly high rates in 2016. For 25-34 year-olds, the rate of opioid deaths increased from 23.4 per 100,000 (2015) to 33.3 per 100,000 (2016). The lowest rates were observed among individuals aged 15-24 years.

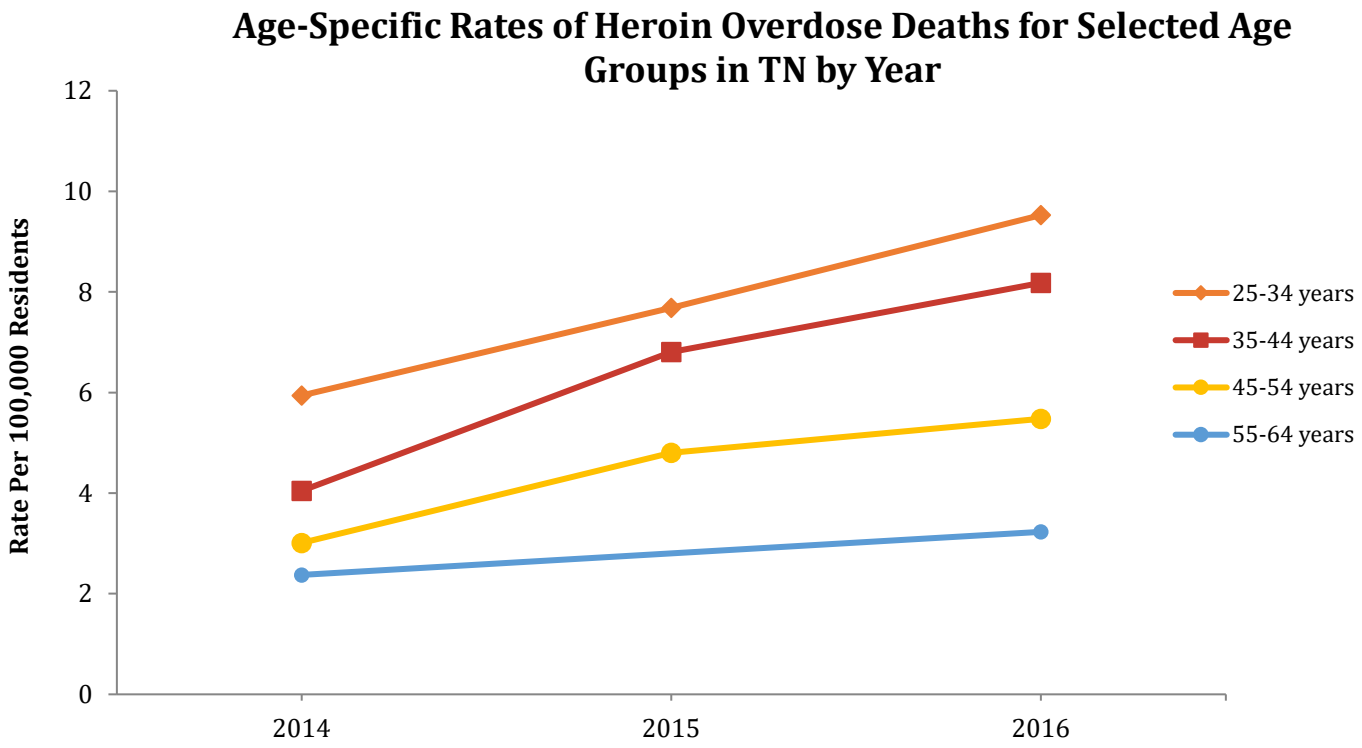



Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents ≥ 15 years. Data Source: TN Death Statistical File.

The below graph of age-specific rates for natural and semi-synthetic opioids, which includes deaths due to prescription opioids such as hydrocodone and oxycodone, shows a different age specific pattern. Specifically, both 25-34 and 35-44 year-olds had lower rates compared to 45-54 year-olds, even in 2016. Further, 55-64 year-olds had higher rates than 25-34 year-olds in 2015 and 2016.




Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents ≥ 15 years. Data Source: TN Death Statistical File.

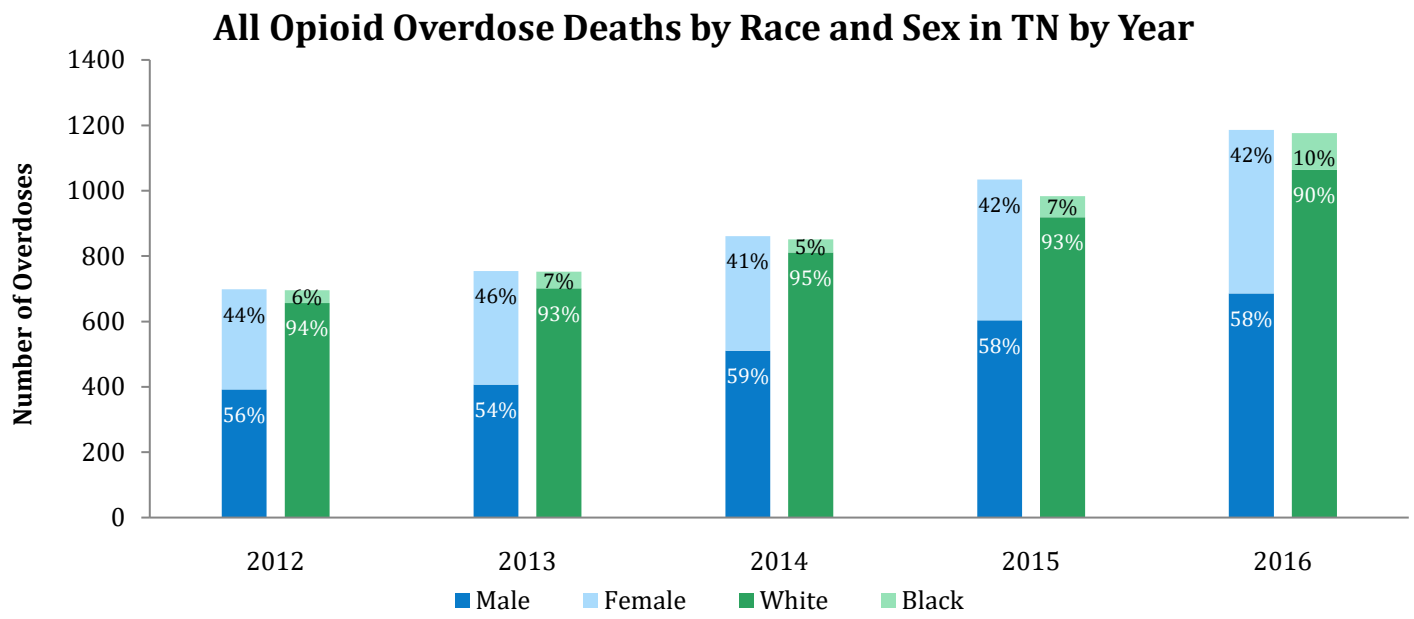



Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Rates for counts <20 were considered unreliable and not calculated for 2012 and 2013. Data Source: TN Death Statistical File.

The above graph displays age-specific rates for heroin overdose deaths in TN for years with adequate sample size for calculation of rates. Individuals aged 25-34 years had the highest rates, with increases from 5.9 per 100,000 in 2014 to 9.5 per 100,000 in 2016. Individuals aged 35-44 years were the age group with the second highest rates of heroin overdose deaths, with increases from 4.0 per 100,000 heroin overdose deaths in 2014 to 8.2 per 100,000 in 2016.

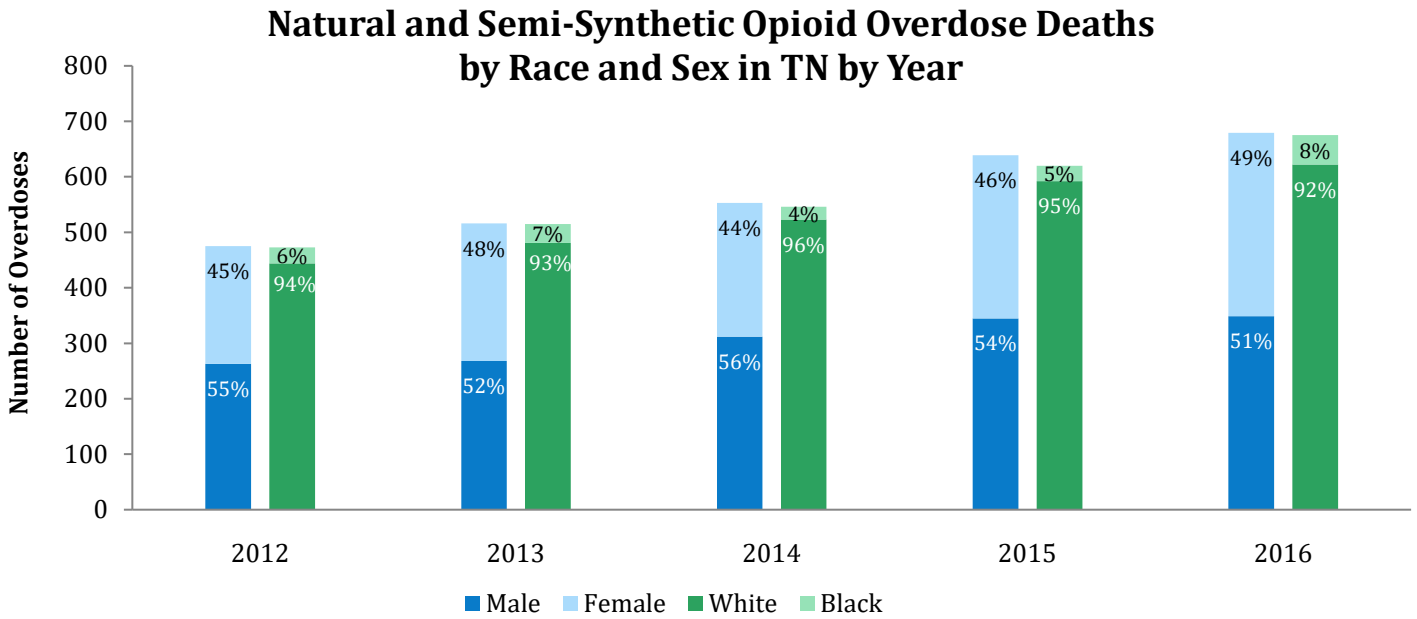
Age-specific patterns for fentanyl were similar to heroin in 2015 and 2016. For individuals aged 25-34 years, the rate of fentanyl overdose death was 4.8 per 100,000 in 2015 and 12.8 per 100,000 in 2016. For individuals aged 35-44, the rate of fentanyl overdose death was 5.0 per 100,000 in 2015 and 8.3 per 100,000 in 2016.[24] Age-specific rates for overdose deaths due to opioid and benzodiazepines combined are shown in Appendix E9.

[24] Appendix E9 provides age-specific counts and rates by type of drug overdose deaths for TN residents.



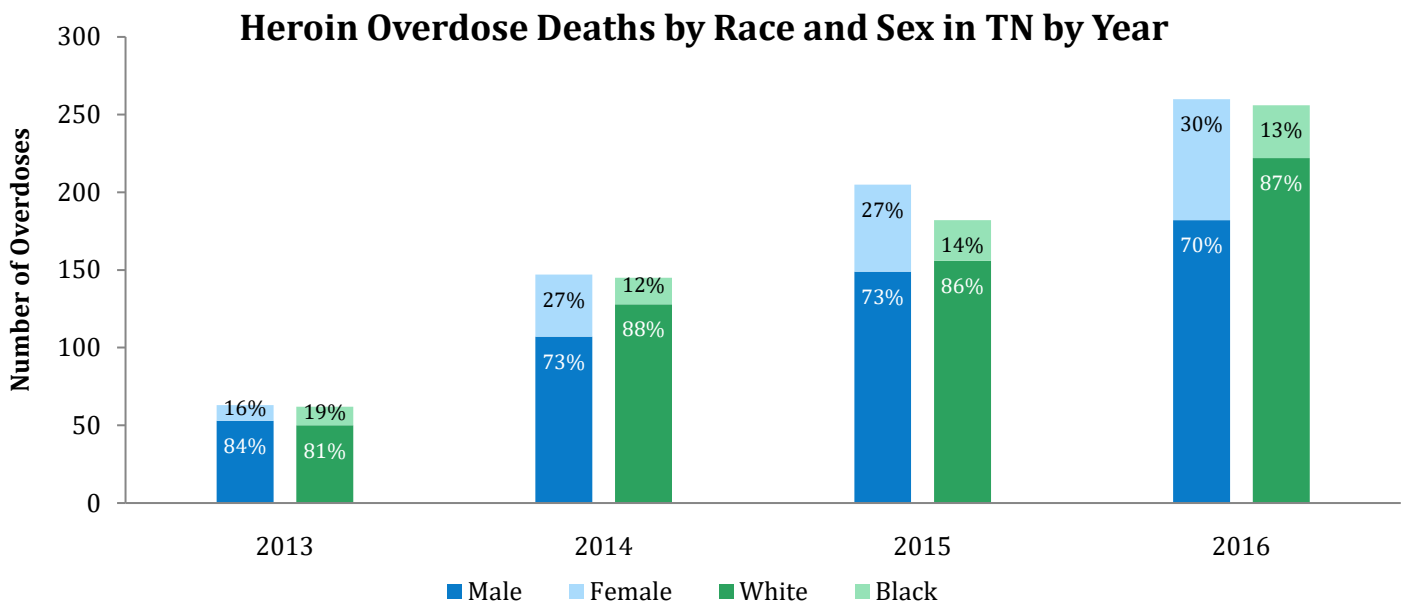

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Limited to Black and White TN residents for analyses by race. Data Source: TN Death Statistical File.

As shown in the graph above, the majority of opioid overdose deaths in TN were among Whites compared to Blacks (≥90%), and among men (≥54%) compared to women, regardless of year.



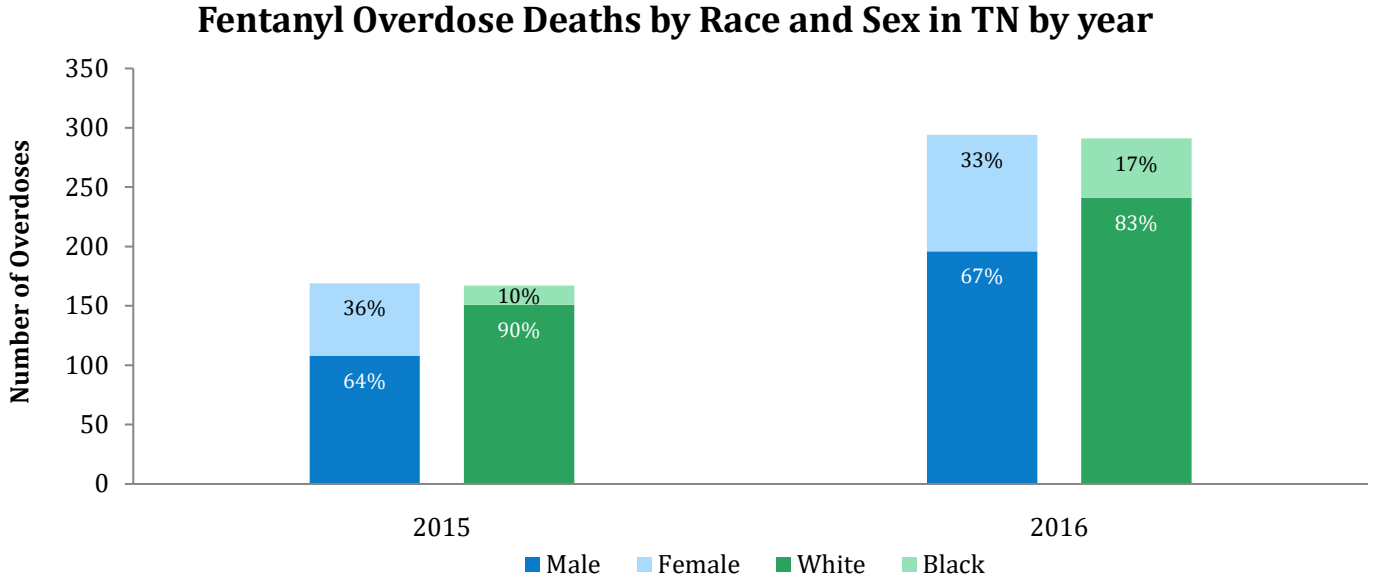

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Limited to Black and White TN residents for analyses by race. Data Source: TN Death Statistical File.

For natural and semi-synthetic opioid overdose deaths, most deaths were among Whites, similar to all opioid deaths. In 2016, the proportions of males and females with a natural and semi-synthetic opioid overdose were similar (49% females, 51% males).




Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Limited to Black and White TN residents for analyses by race. Data Source: TN Death Statistical File.

Among heroin overdose deaths, 81-88% of deaths were among Whites by year. The majority of heroin decedents were male.

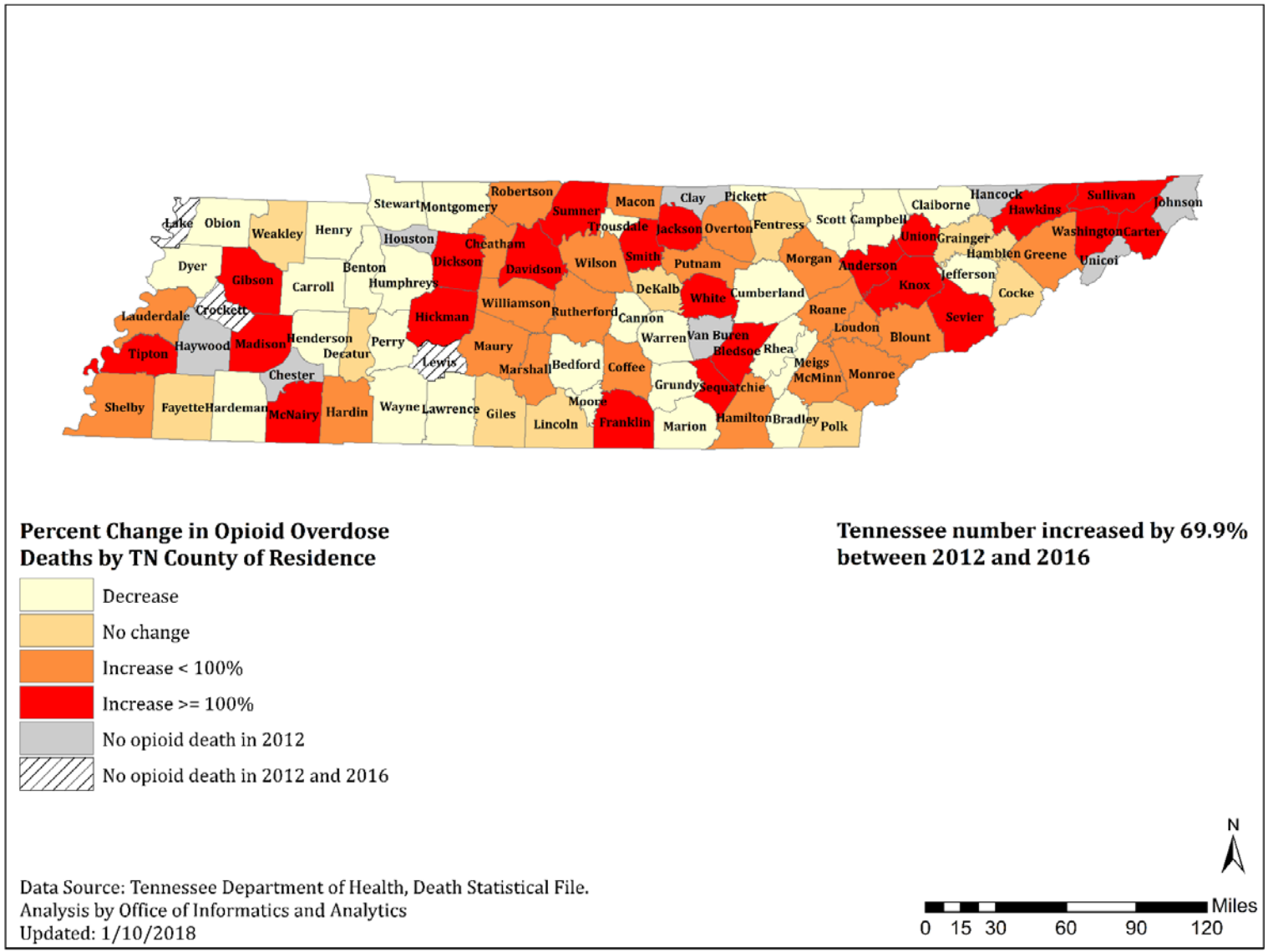



Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Limited to Black and White TN residents for analyses by race. Data Source: TN Death Statistical File.

Among fentanyl overdoses, Whites and males were most affected, similar to the pattern observed for heroin overdose deaths. However, the data is limited to only two years[25] and characteristics of fentanyl overdose deaths may change in future years.

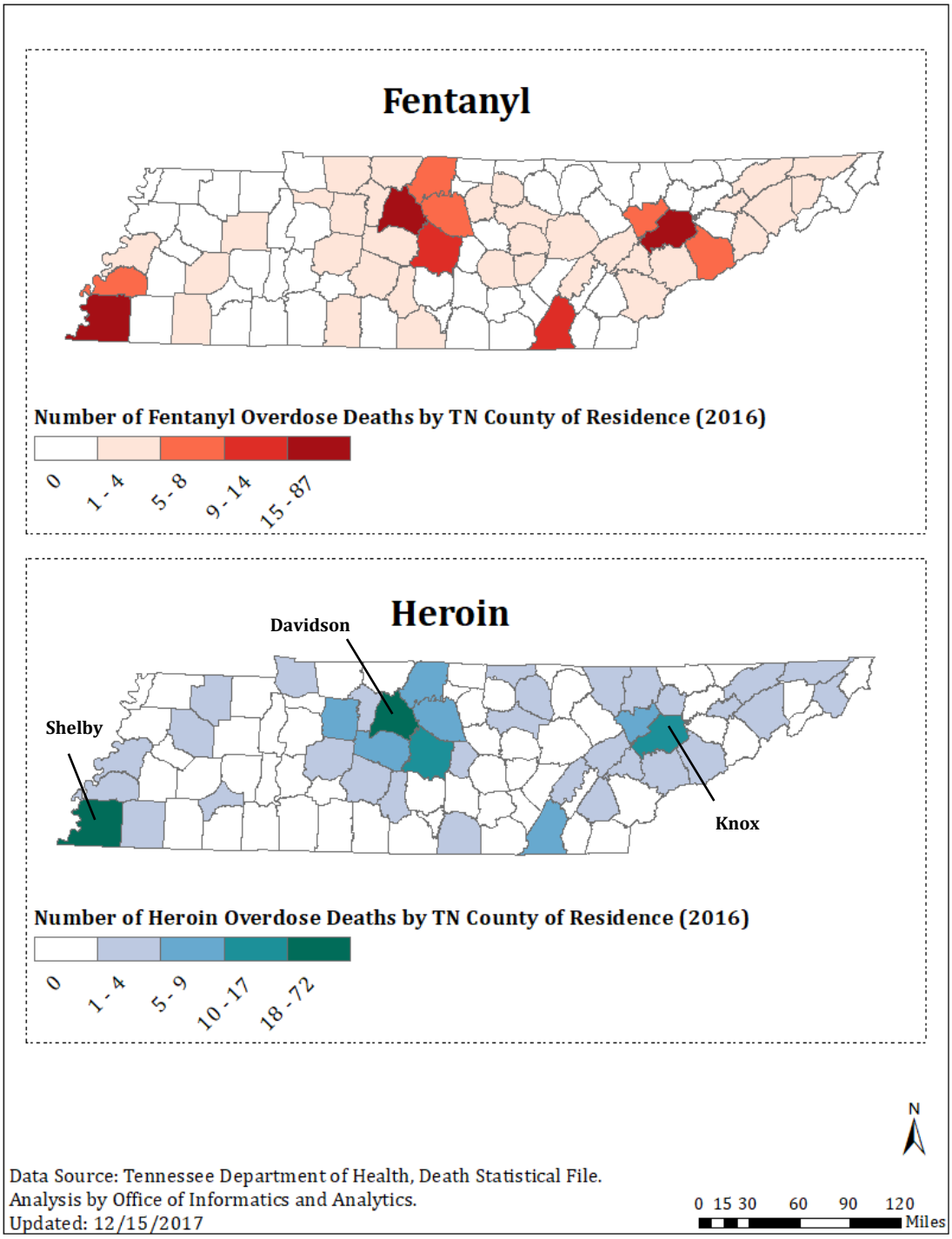
[25] Fentanyl graph limited to years 2015 to 2016 due to small numbers.

## Percent Change in Number of Opioid Drug Overdose Deaths by TN County of Residence, 2012-2016[26]



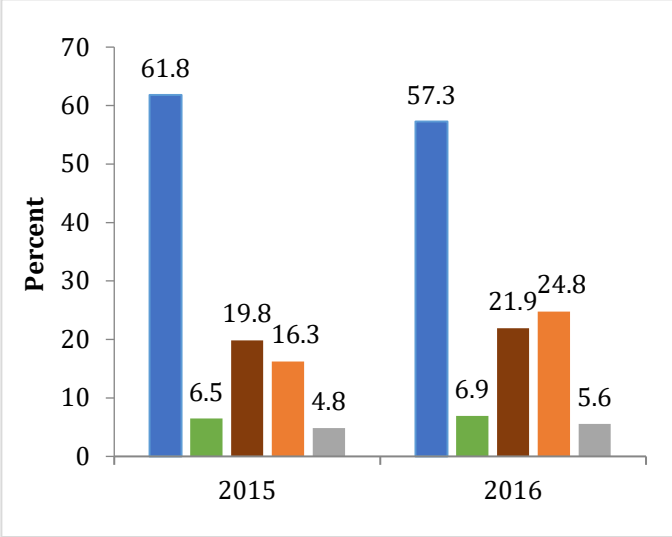

[26] Rates by county were not calculated due to small sample sizes, which would result in unreliable rates. Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 deaths to 197 deaths is an absolute change of 67 overdose deaths, but a percent change of 51.5%.

**Number of Fentanyl and Heroin Overdose Deaths by TN County of Residence, 2016**

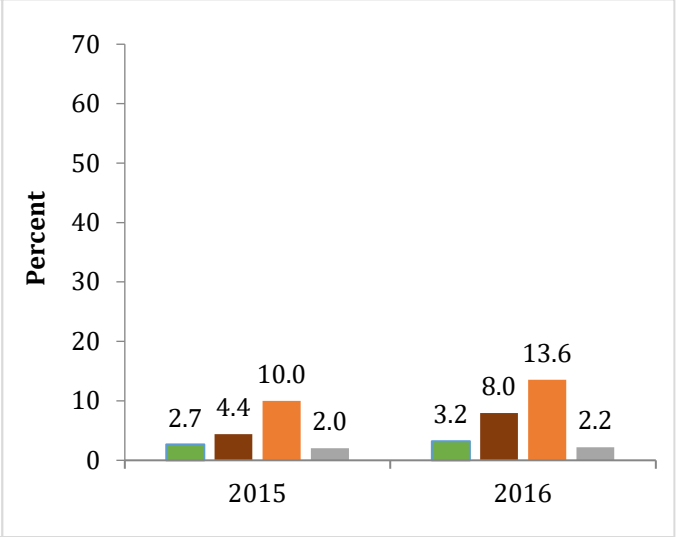



As shown in the map, metropolitan areas and the surrounding counties were the most affected by fentanyl and heroin overdose deaths, including Davidson (includes city of Nashville), Shelby (includes city of Memphis), and Knox Counties (includes city of Knoxville).

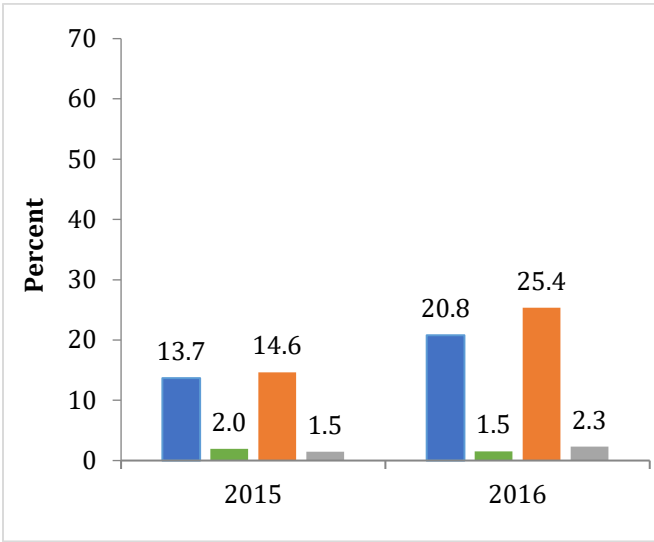
**Contributing Opioids among Opioid Overdose Deaths in TN by Year**



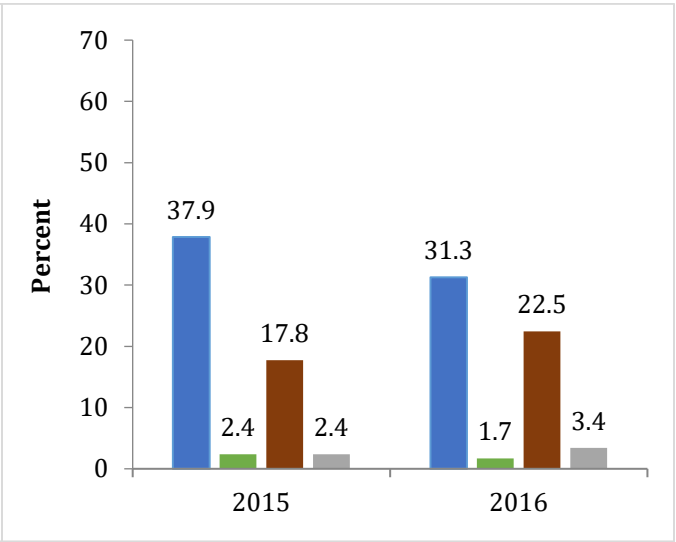

**Contributing Opioids among Natural and Semi-Synthetic Opioid Overdose Deaths in TN by Year**




**Contributing Opioids among Heroin Overdose Deaths in TN by Year**




**Contributing Opioids among Fentanyl Overdose deaths in TN by Year**





Categories are not mutually exclusive. Analysis by the Office of informatics and Analytics (December 15th, 2017), TDH. Limited to TN Residents. Data Source: TN Death Statistical File.

Multiple opioids were involved in opioid overdose deaths, with percentages varying by type of death. Heroin was involved in 19.8% and 21.9% of all opioid overdose deaths in 2015 and 2016, respectively. Fentanyl was involved in 16.3% and 24.8% of all opioid overdose deaths in 2015 and 2016, respectively. In 2016, heroin was involved in 22.5% of fentanyl deaths, but only 8% of natural and semi-synthetic prescription opioid overdose deaths.

## Epidemiology Methods: Using Death Certificate Data

Drug overdose death statistics are derived from the TDH Death Statistical Files.[27] This file contains death certificate information for all individuals who have died in the state of Tennessee as well as Tennessee residents who died out of state. For in-state deaths, causes of death are approved by county medical examiners and standardized by the CDC's National Center for Health Statistics (NCHS) using ICD-10 codes.[28] The ICD-10 coding scheme classifies drug overdose deaths as poisonings and provides information on intent and contributing substance. Because each state sends death certificate data to NCHS for ICD-10 coding, death statistics can be compared between states and against national numbers.

Although updated and revised periodically, the ICD-10 only contains information about contributing substance for general classes of opioid (e.g., natural or synthetic) and a few specific types (e.g., heroin or methadone). While these codes provide a reasonably reliable standard for classifying and comparing overdose deaths across jurisdictions, they do not always classify deaths with the specificity that the shifting trends in the opioid epidemic necessitates.[29] For example, despite the sharp increase in fentanyl deaths in Tennessee between 2012 and 2016, there is currently no ICD-10 code that specifically identifies a fentanyl-involved death. To overcome this in Tennessee, we have devised methods for scanning and summarizing the text fields that comprise cause of death information. Specifically, for deaths due to fentanyl or buprenorphine, we search the literal text of the causes of death on the certificate to identify these deaths using search strings developed based on literature review, visualizing terms and commons misspellings present in TN's death certification data.[30]

Sole reliance on death certificate information and NCHS coding introduces potential sources of misclassification of drug overdose deaths in Tennessee, with several of these issues outlined in the sections below. One key note is that currently OIA analysts are not able to incorporate data from the medical examiners' death reports to enhance drug overdose death surveillance. Medical examiner data, including autopsy and toxicology reports, contain additional information about the circumstances surrounding death that may contribute to higher specificity of overdose identification, including specific drugs involved in deaths.[31] The TDH medical examiner case management system has been recently established to store these reports in a database that may be combined with death certificates. Only some drug overdose decedents in Tennessee are given toxicology tests and autopsies to determine cause of death. Death certificate information received from other states does not currently include any cause of death text, so we cannot classify contributing substances that are only identifiable using this information among out of state deaths.

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[27] Tennessee Department of Health. Bureau of Policy, Planning and Assessment. Division of Health Statistics. Death Statistical File User Manual. January 2014.

[28] Https://www.cdc.gov/nchs/nvss/instruction_manuals.htm

[29] Ossiander EM: Using textual cause-of-death data to study drug poisoning deaths. *Am J Epidemiol* 2014, 179(7):884-894;Slavova S, O'Brien DB, Creppage K, Dao D, Fondario A, Haile E, Hume B, Largo TW, Nguyen C, Sabel JC *et al*: Drug Overdose Deaths: Let's Get Specific. *Public Health Rep* 2015, 130(4):339-342.

[30] Trinidad JP, Warner M, Bastian BA, Minino AM, Hedegaard H. Using Literal Text From the Death Certificate to Enhance Mortality Statistics: Characterizing Drug Involvement in Deaths. Natl Vital Stat Rep. 2016 Dec;65(9):1-15.

[31] Goldberger BA, Maxwell JC, Campbell A, Wilford BB: Uniform standards and case definitions for classifying opioid-related deaths: recommendations by a SAMHSA consensus panel. *J Addict Dis* 2013, 32(3):231-243.

## Cause of Death Data Quality

Completeness of cause of death information is critical for mortality statistics to monitor trends and evaluate opioid-related mortality burden in susceptible populations. Information on specific types of drugs may be missing from the death certificate based on availability of toxicology analysis and drug reporting differences by time and by jurisdiction. This can result in underestimates of the contribution of drug class and types to drug overdose deaths.

Epidemiologists used the following ICD-10 codes to identify incomplete cause of death information in the death certificate data:

- R99: Cause of death is blank, listed as 'PENDING,' or listed as 'UKNOWN'
- T509: Cause of death is drug overdose, but the type of drug involved is unknown
- T406: Cause of death is opioid overdose, but the type of opioid involved is unknown

When determining the percentages of these deaths in the TN death records, we compare R99 deaths to the total number of deaths, T509 deaths to the total number of drug overdoses, and T406 deaths to the total number of opioid overdoses. As shown in Table below, information on cause of death and type of drugs involved in overdose deaths has improved during 2012-2016.

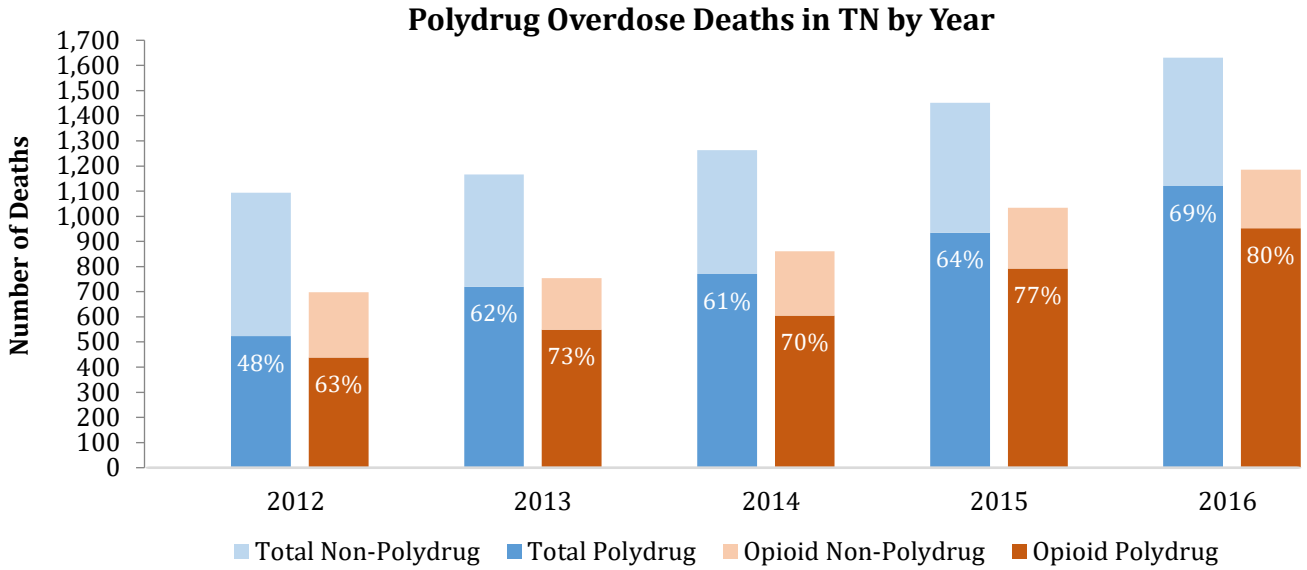
**Death Certificate Data Quality Indicators for Cause of Death Information, 2012-2016**

| | 2012 | | 2013 | | 2014 | | 2015 | | 2016 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % |
| **R99 Deaths** | 1,382 | 2.1 | 1,099 | 1.6 | 922 | 1.3 | 965 | 1.4 | 860 | 1.2 |
| **T509 Deaths** | 180 | 15.8 | 204 | 16.8 | 169 | 12.7 | 128 | 8.4 | 142 | 8.2 |
| **T406 Deaths** | 71 | 9.8 | 73 | 9.3 | 67 | 7.4 | 58 | 5.4 | 36 | 2.9 |

**Data source:** TN death statistical Files

**Identifying Polydrug Deaths in TN: A Brief Summary**

We identified 4,516 deaths in the TN death records from 2012 to 2016 that involve usage of multiple drugs (i.e., polydrug deaths). Of these, 4,263 are classified as having an underlying cause of death of *drug overdose*. When we analyzed these deaths by year, we observed two important trends, shown in the below figure. First, the number of polydrug deaths is increasing in TN. Second, the proportion of overdose deaths that are polydrug is increasing as well. In 2012, 48% (524 out of 1,094 total) overdoses were identified as polydrug, but in 2016, that percentage rose to 69% (1,120 out of 1,631 total). These patterns are also observed among opioid deaths, with polydrug opioid deaths increasing from 63% of the total (438 out of 698) in 2012 to 80% of the total (952 out of 1,186) in 2016.




Analysis by Office of Informatics & Analytics. Last updated December 2017. Data Source: TN Death Statistical File.

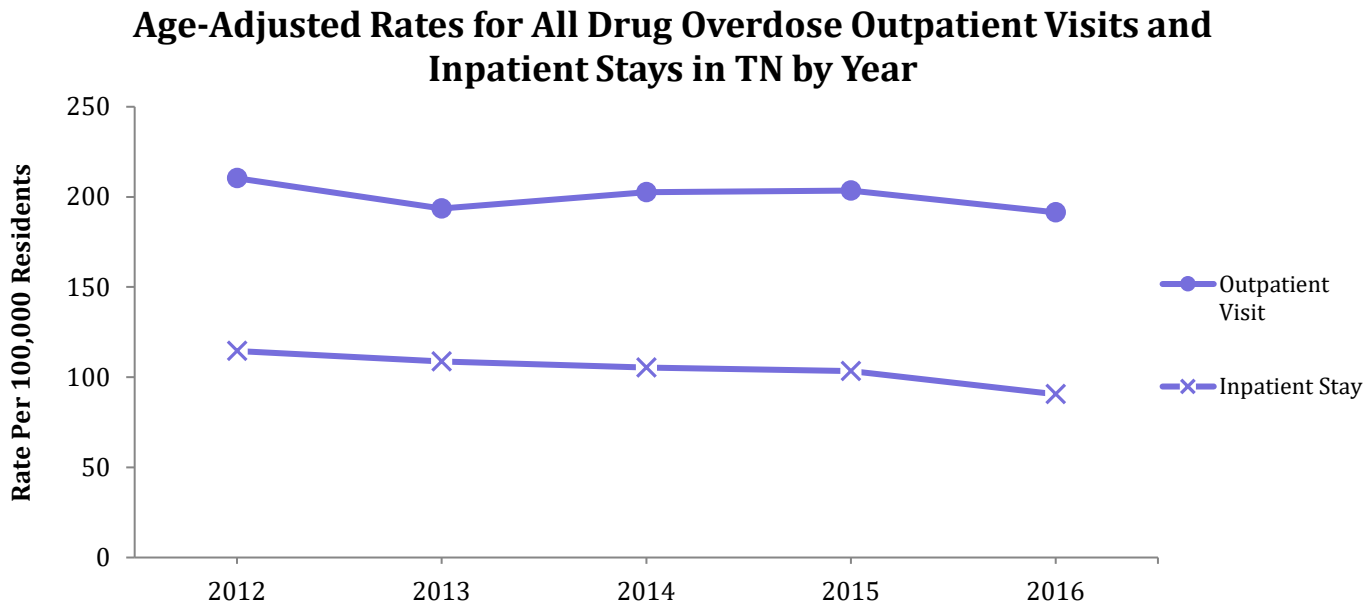
## Future Work

Ideally, combined data from death certificates, autopsy reports, toxicology results, and death scene investigations would improve our ability to understand the role of specific opioids and emerging drugs (e.g., fentanyl analogs) in overdose deaths. Incorporation of medical examiners data in 2017 into the integrated data system with access for epidemiologists (described in Appendix B) is a key step toward providing data that could contribute to improved measurement of the role of opioids in overdose deaths in TN for analyses. We have plans to expand our literal text searches to identify additional specific types of drugs and emerging drugs (e.g. fentanyl analogs) based on death certificate data. Our PDO team student analyst, Molly Golladay, has prepared a presentation on issues to consider for improving death certificate measurement based on an analysts' perspective available on our website.[32] This information could be used to identify errors for improvement in death certificate completion, as feasible based on resources. Analyses are in progress to understand trends in polydrug deaths over time in TN from 2013 to 2016 and by key population characteristics and type of opioid overdose death. Additional ongoing analyses using TDH mortality data, with linkage to the CSMD, are described in the below section, ***Ongoing PDO Team CDC-Funded Analytic Projects***.

[32] https://www.tn.gov/content/dam/tn/health/documents/opioid_response/Web_Friendly_Death_Certificate_Presentation_FINAL.pdf

# Non-Fatal Drug Overdose Hospital Discharges in Tennessee, 2012-2016

## All Drug Overdose Hospital Discharges



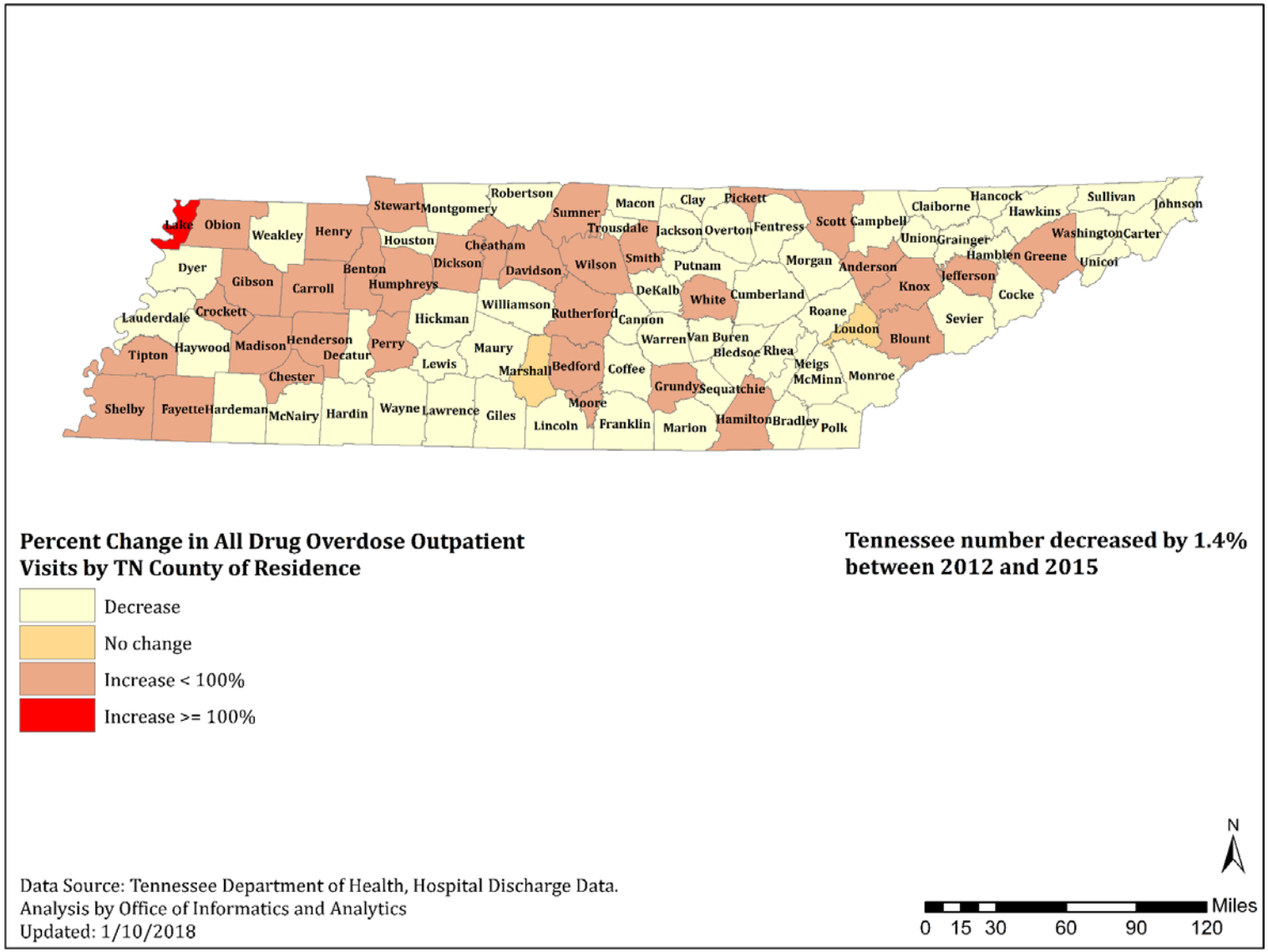

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data Source: Hospital Discharge Data. **On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.**

The above graph shows age-adjusted rates for all drug overdose[33] outpatient visits and inpatient stays in TN during 2012 to 2016. For outpatient visits,[34] the age-adjusted rates decreased and ranged from 210.3 per 100,000 in 2012 to 191.4 per 100,000 in 2016. For inpatient stays, the age-adjusted rates decreased from 114.5 per 100,000 in 2012 to 90.6 per 100,000 in 2016.

It is important to note that all drug overdoses were defined using ICD-9-CM diagnosis codes through September 30th 2015 and using ICD-10-CM coding, implemented on October 1st 2015, thereafter. The coding change from ICD-9-CM to ICD-10-CM involved substantial changes. For example, ICD-9-CM included 2,600 injury diagnosis codes and 1,300 external cause of injury codes compared to 43,000 injury diagnosis codes and 7,500 external cause of injury codes in ICD-10-CM.[35] The coding change has been shown to influence opioid-related measures based on hospital discharge data[36] and it is important to consider this in the interpretation of trends before and after the coding change implementation. We are actively participating in a national workgroup that is conducting analyses by US jurisdiction to understand the impact of coding changes on opioid-related outcomes, and the best approaches for defining opioid-related indicators using ICD-10-CM data (see below section **Future Work**).

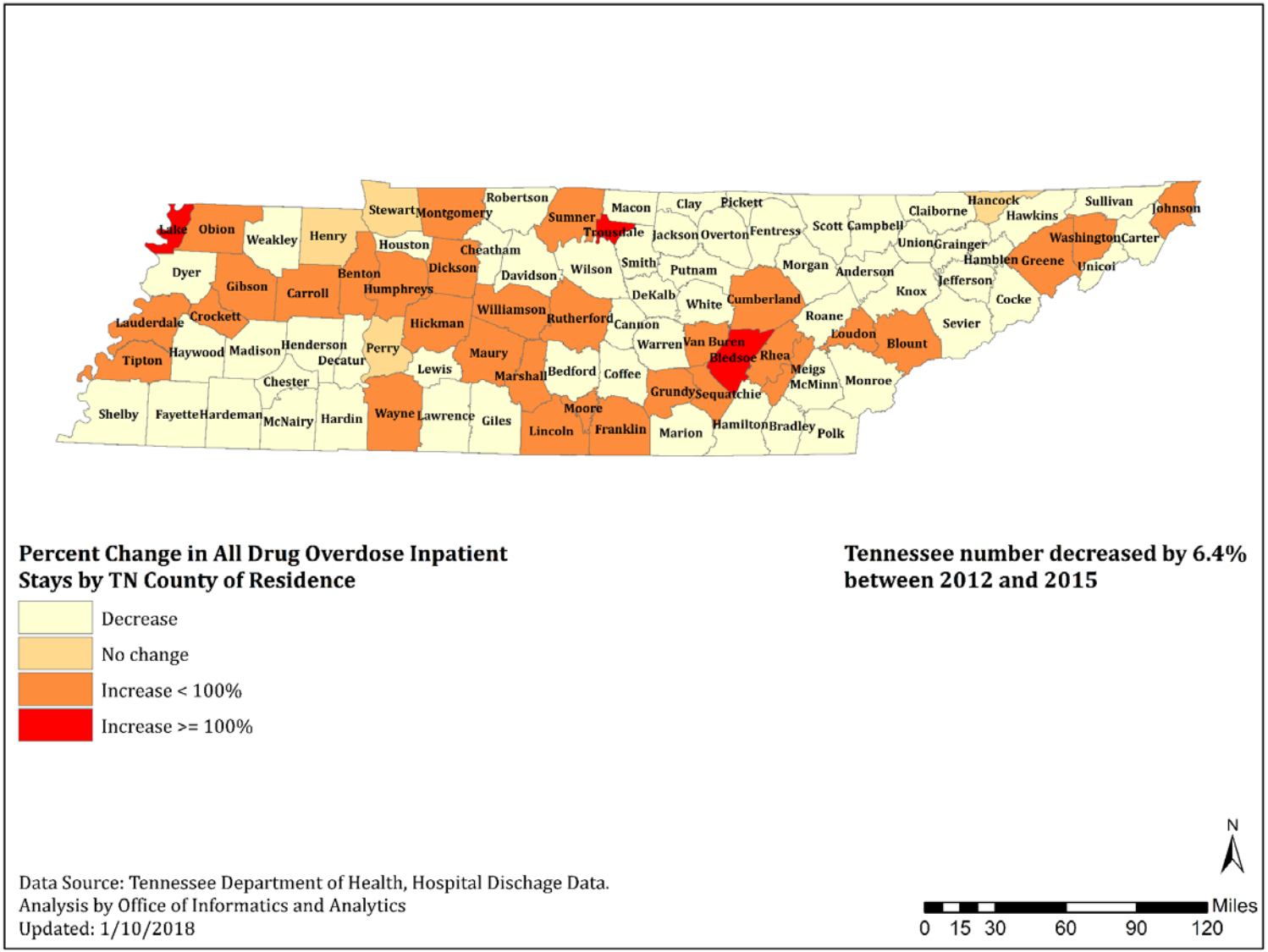
[33] All drug overdose outpatient visits and inpatient status are defined as drug overdoses caused by non-fatal acute poisonings due to the effects of drugs, regardless of intent (e.g., suicide, unintentional, or undetermined).
[34] Outpatient visits include primarily emergency department visits, but also include any observation 23 hours or less, ambulatory surgeries or certain diagnostic services (such as MRIs or CT scans).
[35] The Transition from ICD-9-CM to ICD-10-CM: Guidance for Analysis and Reporting of Injuries by Mechanism and Intents. A report from the Injury Surveillance Workgroup (ISW9) Safe States Alliance. December 2016.
[36] Moore BJ, Marrett ML. Case Study: Exploring How Opioid-Related Diagnosis Codes Translate from ICD-9-CM to ICD-10-CM. April 2017. U.S. Agency for Healthcare Research and Quality.

**Percent Change in Number of All Drug Overdose Outpatient Visits by TN County of Residence, 2012-2015[37]**



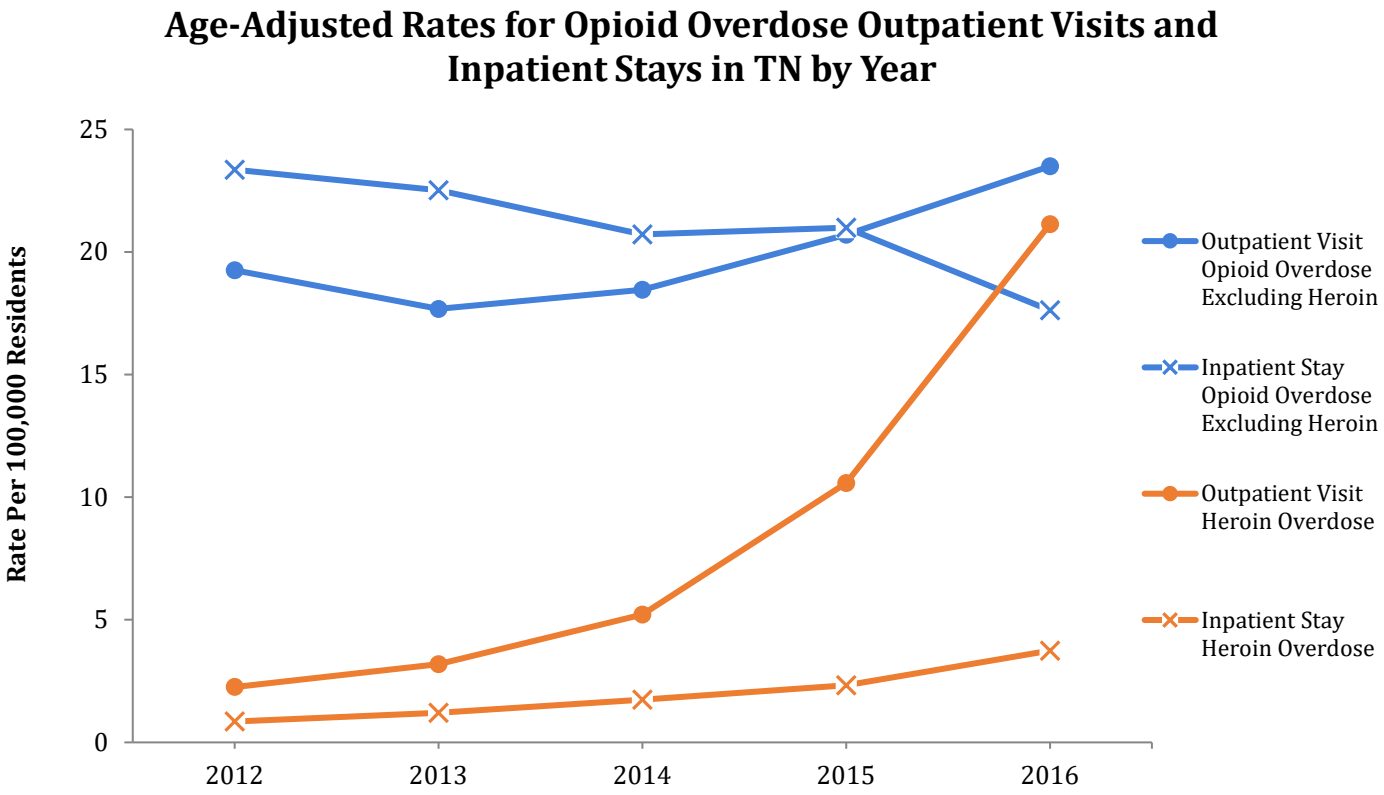

[37] Rates by county were not calculated due to small sample sizes, which would result in unreliable rates. Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 deaths to 197 deaths is an absolute change of 67 overdose deaths, but a percent change of 51.5%.

**Percent Change in Number of All Drug Overdose Inpatient Stays by TN County of Residence, 2012-2015[38]**




[38] Rates by county were not calculated due to small sample sizes, which would result in unreliable rates. Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 deaths to 197 deaths is an absolute change of 67 overdose deaths, but a percent change of 51.5%.

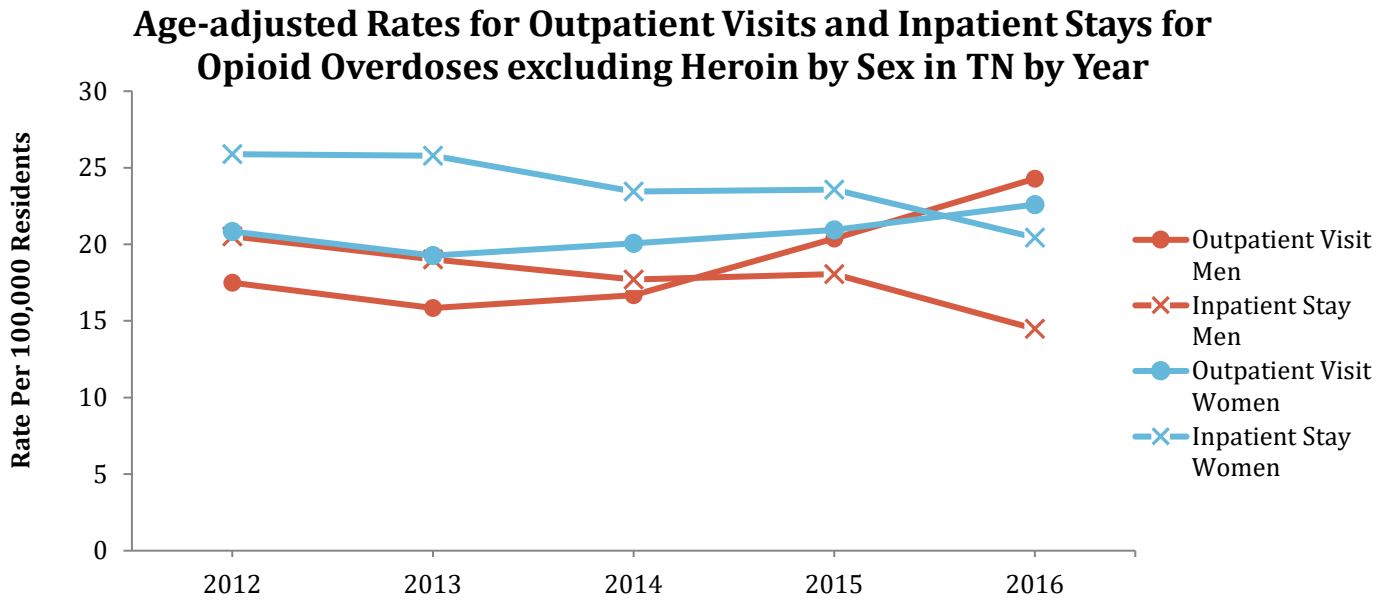
## Opioid-Related Overdose Hospital Discharges




Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data Source: Hospital Discharge Data. **On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.**

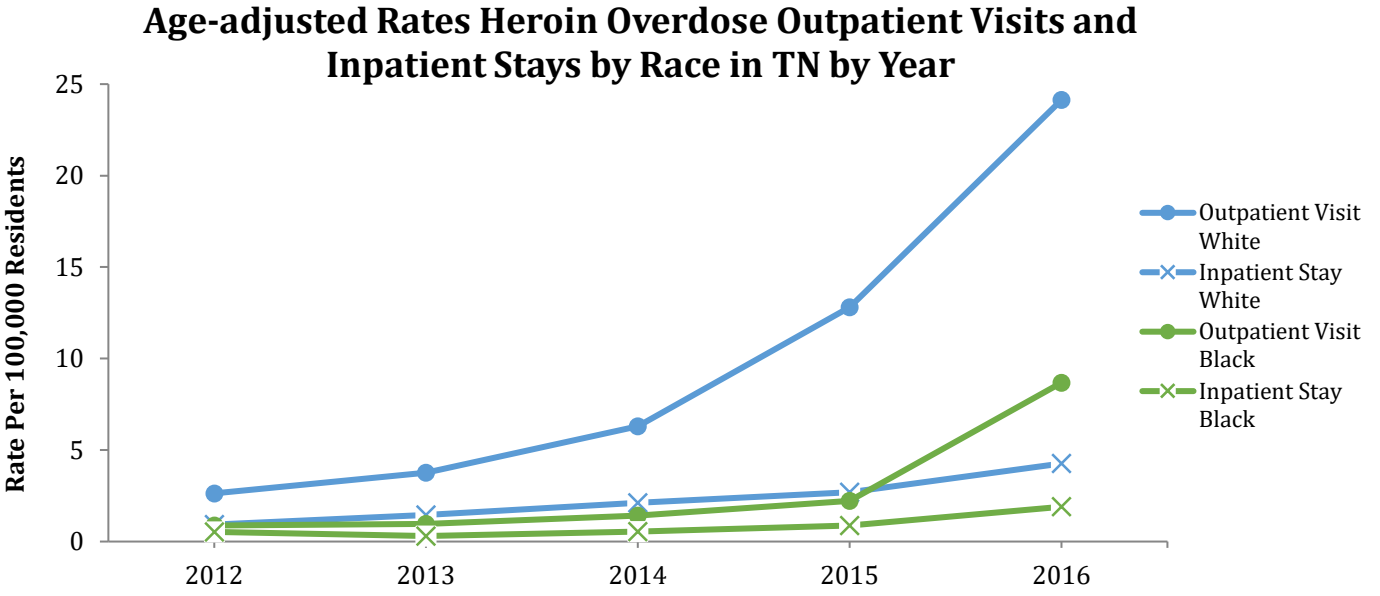
Age-adjusted rates for outpatient visits and inpatient stays for both non-heroin opioid related overdoses[39] and heroin overdoses[40] are shown above. Outpatient visits for non-heroin opioid overdoses increased from 2014 to 2016, and surpassed inpatient stays for non-heroin opioid overdoses. Inpatient stays for heroin overdoses remained low, with a small increase observed from 2014 to 2016. In contrast, a large increase was observed for outpatient visits for heroin (2.3 per 100,000 in 2012 to 21.1 per 100,000 in 2016).

[39] Opioid overdoses excluding heron inpatient stays or outpatient visits caused by non-fatal acute poisonings due to the effects of all opioids drugs, excluding heroin, regardless of intent (e.g., suicide, unintentional, or undetermined). Identified using ICD-9-CM diagnosis codes through September 30th 2015 and thereafter using ICD-10-CM diagnosis codes (see Appendix C, Technical Notes for specific codes).
[40] Heroin overdose inpatient stays or outpatient visits caused by non-fatal acute poisonings due to the effects of all opioids drugs, excluding heroin, regardless of intent (e.g., suicide, unintentional, or undetermined). Identified using ICD-9-CM diagnosis codes through September 30th 2015 and thereafter using ICD-10-CM diagnosis codes (see Appendix C, Technical Notes for specific codes).




Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data Source: Hospital Discharge Data. **On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.**

Women had higher inpatient stays for non-heroin opioid overdoses than men and rates decreased for both men and women during 2012 to 2016. Rates for outpatient visits for non-heroin opioid overdoses were also higher for women through 2015, when rates for men surpassed rates for women, with high increases seen among men from 17.5 per 100,000 in 2012 to 24.3 per 100,000 in 2016.

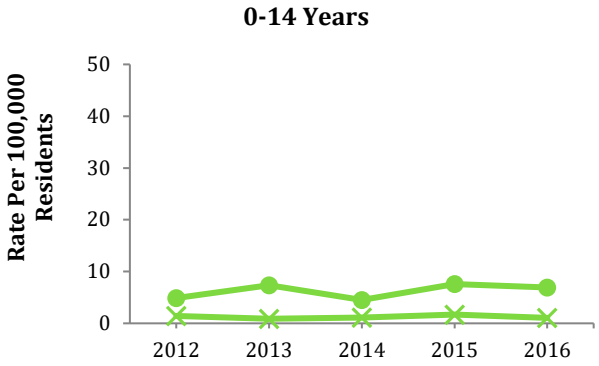


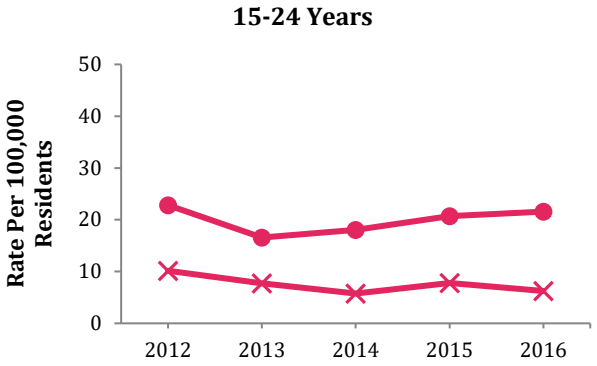

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data Source: Hospital Discharge Data. **On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.**

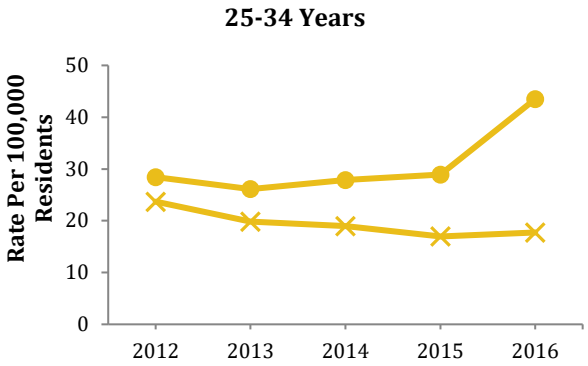
The highest rates were for outpatient visits among whites, with a substantial increase from 2.6 per 100,000 in 2012 to 24.1 per 100,000 in 2016. An increase in rate for outpatient visits was observed among Blacks from 2015 (2.2 per 100,000) to 2016 (8.7 per 100,000).

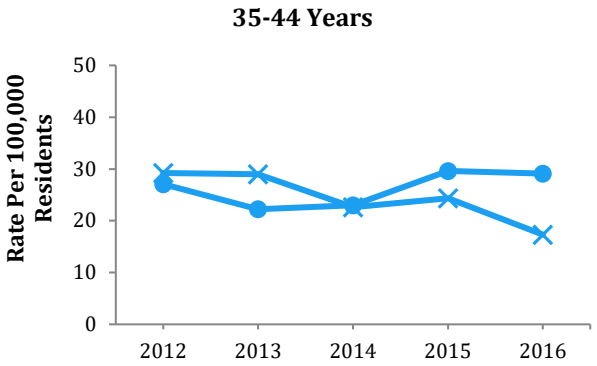
# Age-Specific Rates for Outpatient Visits and Inpatient Stays for Opioid Overdoses excluding Heroin by age in TN by Year

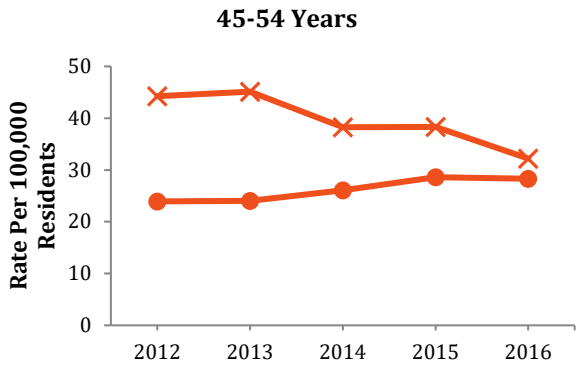
For all graphs, '•' refers to outpatient visits and 'x' refers to inpatient stays

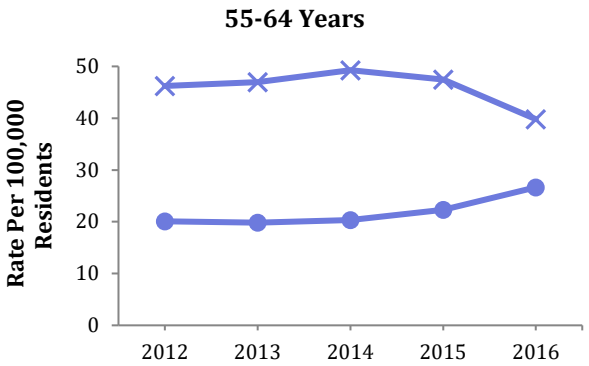


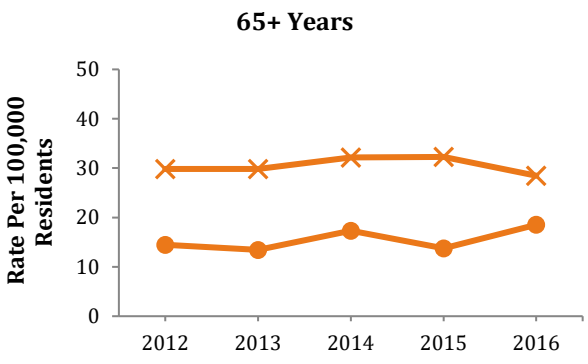



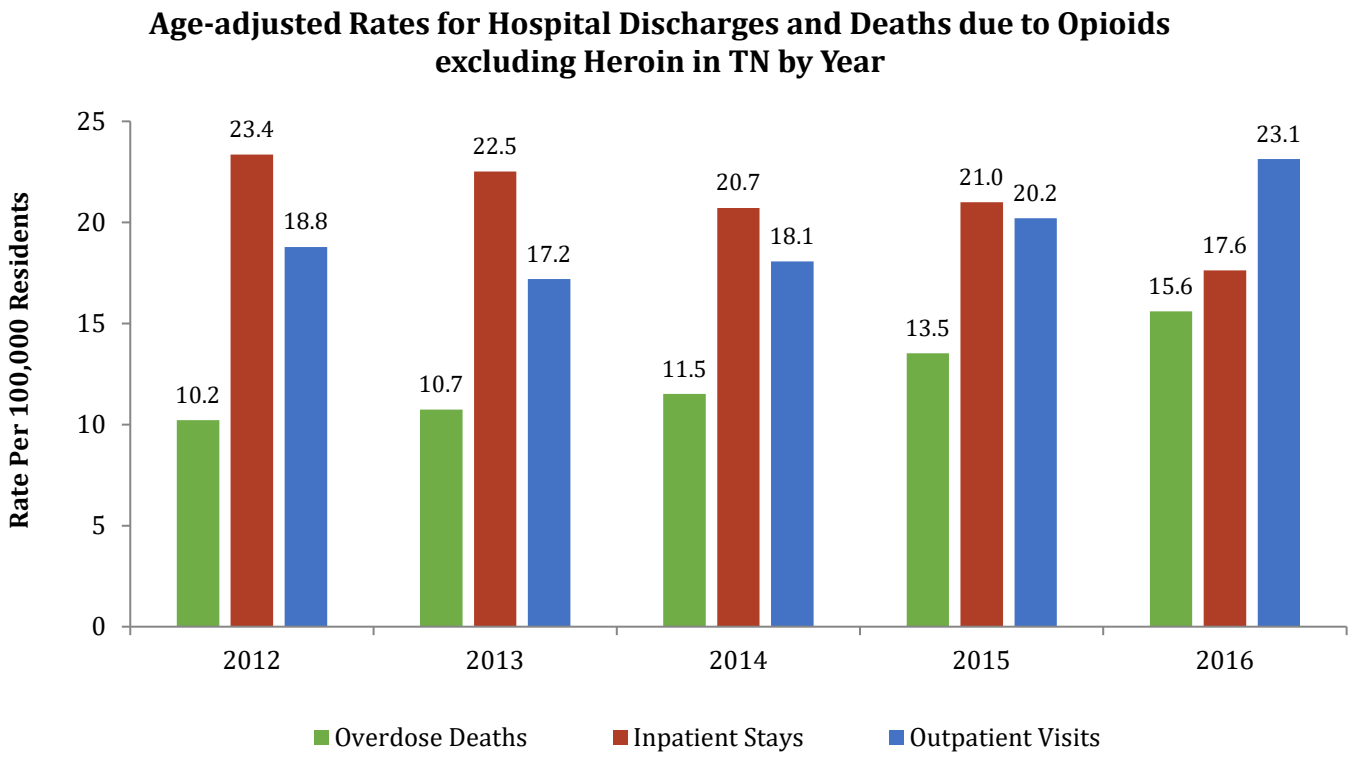



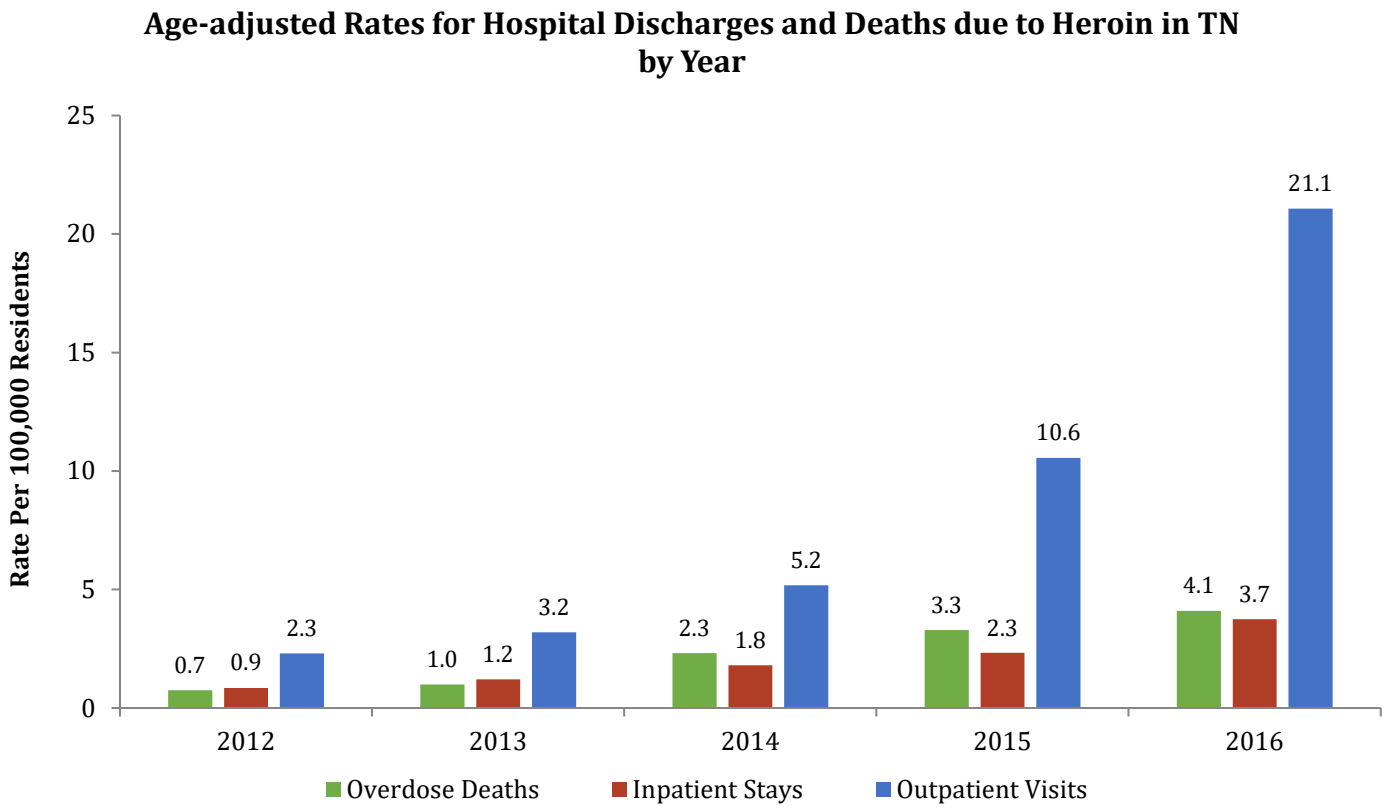

Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data source: Hospital Discharge Data.




Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data source: Hospital Discharge Data. **On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.**

In TN, from 2012 to 2016, the age-adjusted opioid (excluding heroin) overdose death rate increased more than 50% with a rate of 10.2 deaths per 100,000 residents in 2012 and a rate of 15.6 deaths per 100,000 residents in 2016. During that same time period in TN, for nonfatal opioid (excluding heroin) overdoses resulting in care and subsequent hospital discharge, the age-adjusted rate of inpatient stays decreased while outpatient visits[41] increased.

[41] Outpatient visits include primarily emergency department visits, but also include any observation 23 hours or less, ambulatory surgeries or certain diagnostic services (such as MRIs or CT scans).

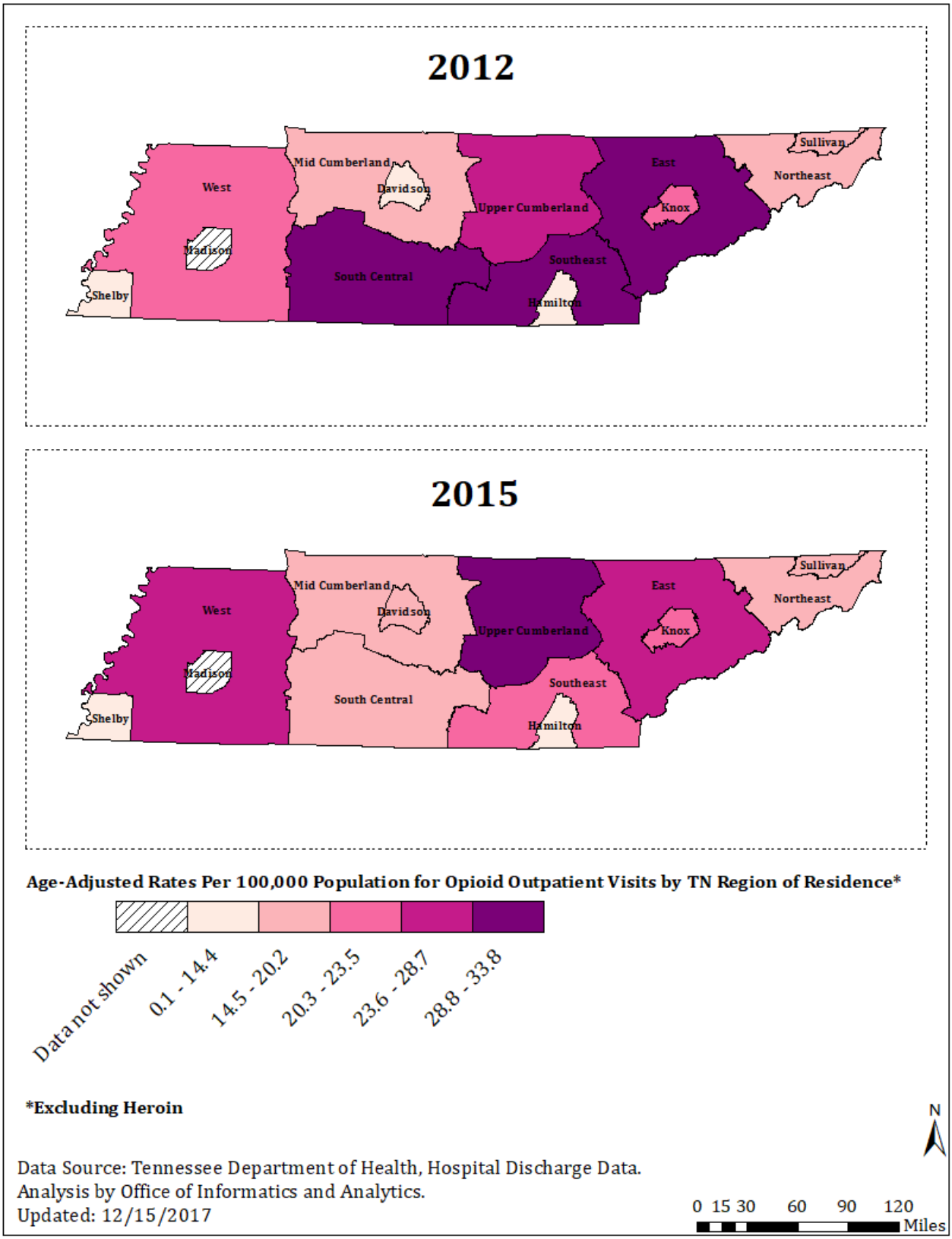



Analysis by the Office of Informatics and Analytics, TDH (last updated December 15, 2017). Limited to TN residents. Data source: Hospital Discharge Data**. On October, 1st 2015 there was a transition from ICD-9 to ICD-10 diagnosis coding, and differences after this change could be due to coding changes, which should be considered in interpretation of trends.** Data source: Hospital Discharge Data.

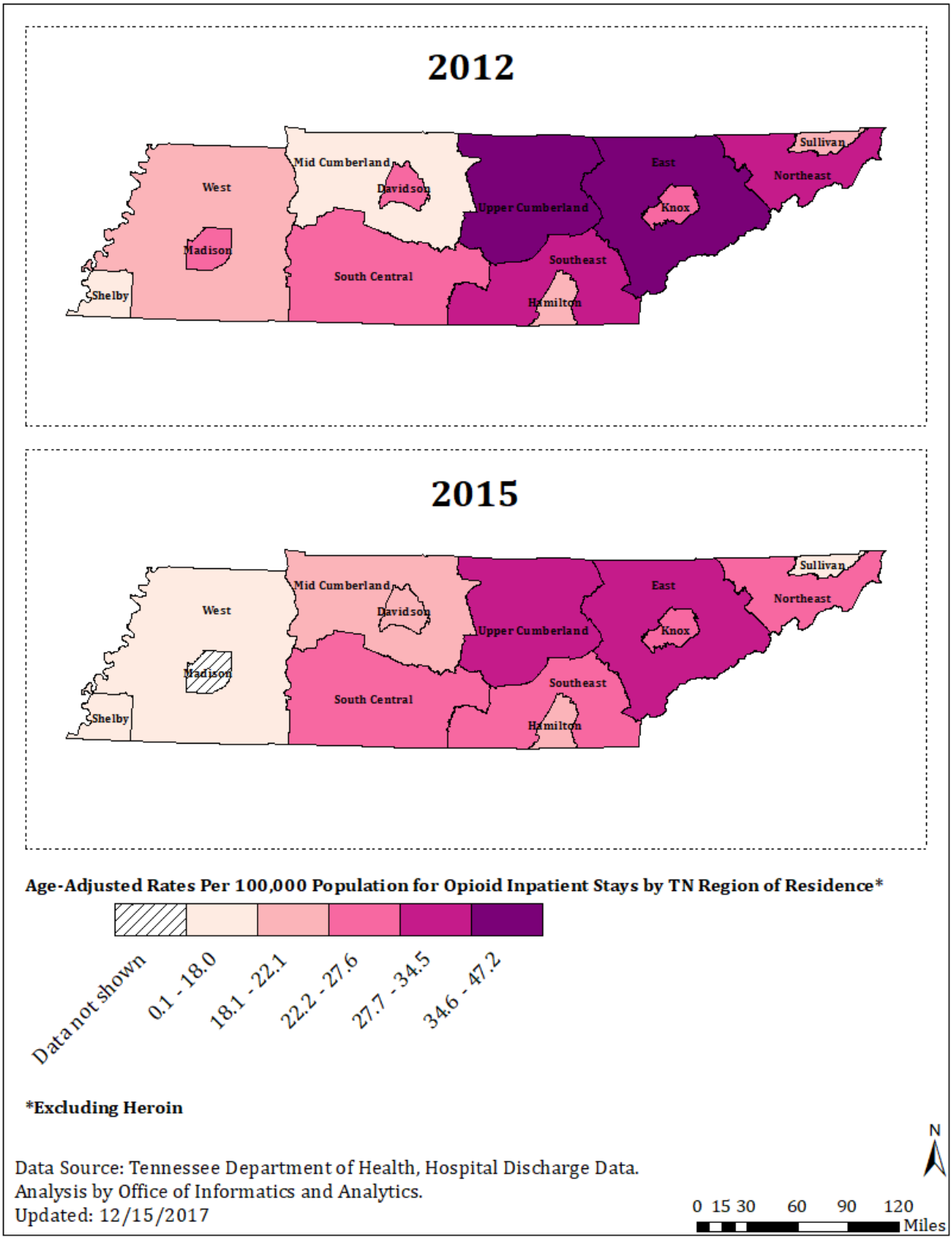
In TN, the age-adjusted heroin overdose death rate in 2016 was over five times the rate in 2012, increasing from 0.7 deaths per 100,000 residents in 2012 to 4.1 deaths per 100,000 residents in 2016. From 2012 to 2016, the age-adjusted rate of non-fatal heroin overdose outpatient[42] visits resulting in care and subsequent hospital discharge increased over nine fold from 2.3 outpatient visits per 100,000 residents to 21.1 outpatient visits per 100,000 residents. During that same time period, the rate of nonfatal heroin overdose inpatient stays resulting in care and subsequent hospital discharge more than quadrupled with rates of 0.9 inpatient stays per 100,000 residents in 2012 and 3.7 inpatient stays per 100,000 residents in 2016.

[42]Outpatient visits include primarily emergency department visits, but also include any observation 23 hours or less, ambulatory surgeries or certain diagnostic services (such as MRIs or CT scans).

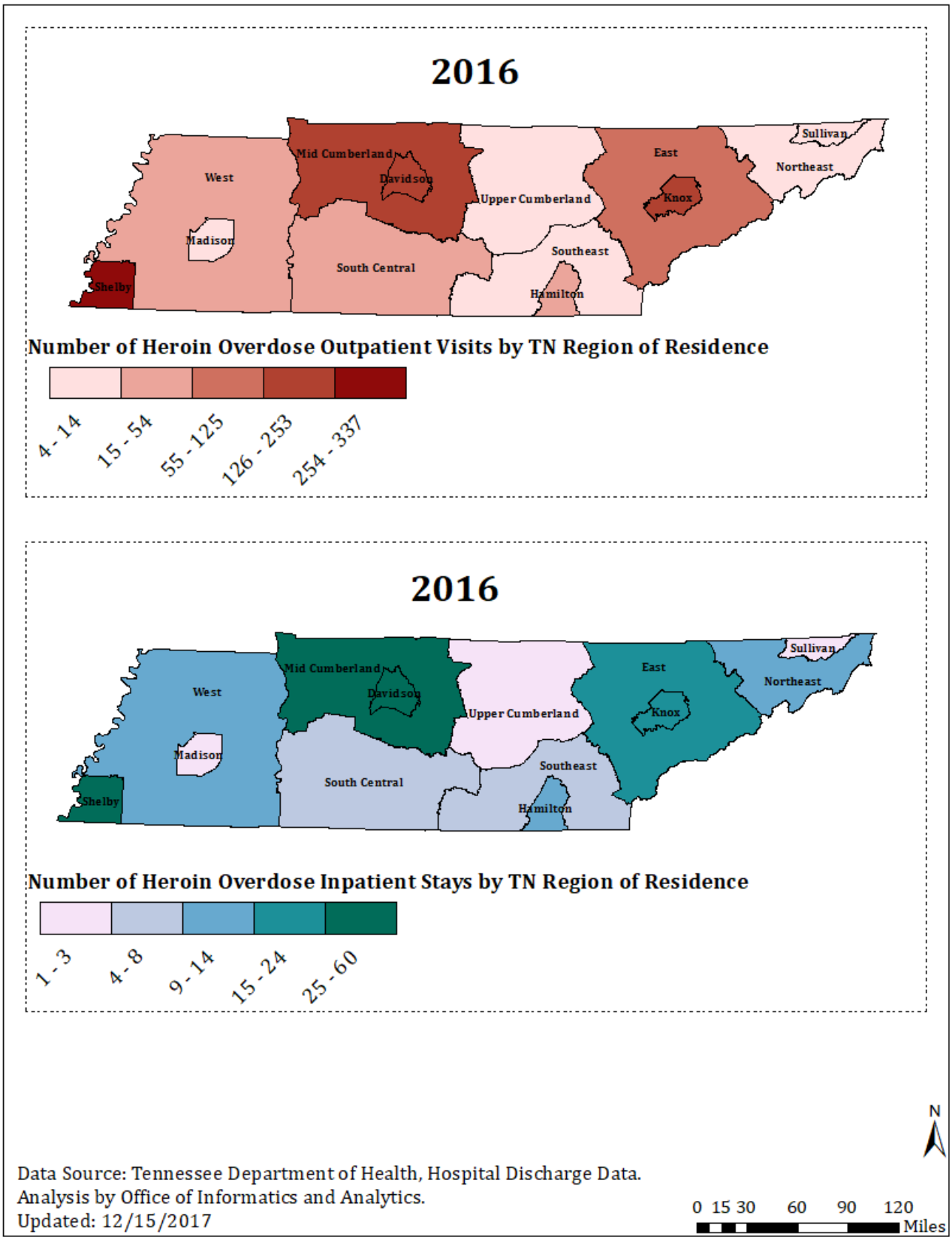
**Age-adjusted Rates (per 100,000 TN residents) for Opioid Excluding Heroin Overdose Outpatient Visits by TN Region of Residence, 2012-2015**



**Age-adjusted Rates (per 100,000 TN residents) for Opioid Excluding Heroin Overdose Inpatient Stays by TN Region of Residence, 2012-2015**



**Number of Heroin Overdose Outpatient Visits and Inpatient Stays by TN Region of Residence, 2016**



## Future Work

PDO team members are participating in the Council for State and Territorial Epidemiologists ICD-10-CM Opioid Poisoning Indicators workgroup. This workgroup brings together population scientists from across the US to develop methodologies for defining drug poisoning morbidity outcomes using administrative data. The overall goal of the workgroup is to conduct collaborative cross-jurisdiction analyses including: 1) development of opioid-related morbidity outcome definitions using ICD-10-CM coding and 2) evaluation of data trends before and after coding change by jurisdiction to inform interpretations and definitions to support national recommendations. We have participated in the in-person kick-off meeting in September 2017, monthly conference calls, provided data visualization templates for use by jurisdictions for reporting, and contributed to analyses by providing TN hospital discharge data. We have several projects utilizing linked CSMD and hospital discharge data described below in ***Ongoing PDO team CDC-funded analytic projects***.

# Ongoing PDO team CDC-funded analytic projects

## PDO Team Ongoing Analyses

| Title | Project Summary |
|---|---|
| 1. Sociodemographic factors, prescription history and opioid overdose deaths in Tennessee: a retrospective analysis using linked statewide data, 2013-2016 | Understanding how prescription opioid use, related prescribing patterns, and other risk factors differ by type of overdose drug death can provide targeted information to support prevention and education efforts to reduce morbidity and mortality in TN. However, these data are lacking for TN. We have linked TN death data to the CSMD to conduct analyses on the role of prescription opioid use in drug overdose deaths among TN adults and identify at-risk populations by type of contributing drugs. |
| 2. Prescription opioid use by injured workers in Tennessee: A descriptive study using linked statewide databases | Injured workers in other states receive opioids at high levels, but little is known about their use by injured workers in TN. To evaluate the prevalence of opioid use after injury in TN workers and trends in groups that are more likely to use opioids, we conducted a descriptive study with linked CSMD and Workers' Compensation records. We investigated the relationship between demographic and clinical variables with receiving an opioid after injury, and found that people with fractures, strains, sprains, and tears, and lower back injuries were more likely to receive an opioid than other injuries, and workers over the age of 35 were more likely to receive an opioid than younger workers. |
| 3. Prescription opioid use during pregnancy and infant birth outcomes in Tennessee | Exposure to opioids in utero may be associated with adverse birth outcomes among infants including preterm birth, low birthweight, and neonatal abstinence syndrome, which can result in short and long-term health consequences and costly health expenditures. We are conducting a comprehensive evaluation of the role prescription opioids and related risk factors in association birth outcomes using statewide linked TDH data. Results can inform prevention strategies to reduce infant and child morbidity due to the opioid epidemic. |
| 4. Injury as a gateway to long-term opioid use in Tennessee workers: A predictive model using linked statewide databases | Uncontrolled opioid use after injury may lead to long-term opioid use, which in turn leads to the potential for opioid-related harms. To build a predictive model for injury as a gateway to long-term opioid use in TN, we are in the process of identifying workers who were opioid-naïve at the time of their injury and following them for six months after injury to evaluate continued prescribing. We are using statistical models to find patterns of demographic and injury characteristics combined with patterns of early opioid prescribing that predict groups of workers who may be vulnerable to long-term opioid use. |
| 5. Evaluation study of the implementation of pain clinic policies | The TDH health economist is conducting a statistically rigorous analysis of laws enacted specifically to target pill mills to identify changes in presence of pill mills, prescribing patterns and other outcomes. An analysis of payment type for opioid and benzodiazepine prescriptions in Medicaid and non-Medicaid populations is also being conducted. |

| | |
|---|---|
| 6. Methodology and descriptive analysis for polypharmacy drug overdoses based on TN Death Certificate Data, 2012-2016 | Polydrug overdose deaths are increasing in the US and in TN. Methods to identify polydrug use are not well-established. The first objective of this study is to develop methods to identify drug overdose deaths involving polydrug use using available death certificate data. The second objective is to evaluate trends and characteristics of polypharmacy drug overdoses in TN during 2013 to 2016. |
| 7. Prescription history among TN residents with an opioid–related inpatient or outpatient hospital visit | Little is known about the types of controlled substances dispensed to TN residents around the time of a non-fatal overdose event. We are conducting a retrospective cohort study using the CSMD and Hospital Discharge database to evaluate the prevalence of filling an opioid or benzodiazepine prescription before and after an overdose event during years 2012-2016. Example study objectives include: 1) determine the proportion of TN residents filling a prescription at varying time intervals before and after a hospital visit (including outpatient or in patient care) for a drug overdose event; and 2) determine if prescription history around overdose events varies by year, age group, sex, race, and comorbidity history. |
| 8. Cohort study of the association of prescribing patterns with risk of opioid overdose outcomes among TN adults | The primary objective of this study is to conduct a valid survival analysis to determine associations between known prescription-related overdose risk factors, carefully considering potential confounders, stratifying variables, and time-dependent covariates and exposure status. This initial work on this project has included a study of drug overdose decedents (see analysis 1 above) and methods development, including patient entity management approaches, to enable valid classification of the population at risk, and study variables for the statistical analysis. |
| 9. Opioid, benzodiazepine, and stimulant prescription patterns among adolescents in TN, 2012- 2016 | This study examines trends in dispensed prescribing patterns among adolescents (12-17 years of age) in TN according to physical demographics, such as sex, race, and age, as well as geographic demographics such as region. The goal is to provide a comprehensive view of how this population has been given access by health care providers to prescribed opioids in TN and how that access has changed with the implementation of new policies. |
| 10. Opioid-related adverse outcomes in injured workers in TN | Little is known on a population level about the frequency with which injured workers using opioids have adverse effects of their opioid use, and the types of adverse effects that occur. To learn more about opioid-related harms in injured workers, we plan to link the CSMD to Workers' Compensation and the Hospital Discharge Dataset to assess hospital and emergency room visits after injury. We will evaluate the prevalence of overdose and other harms that have been documented in injured workers in other states and their patterns and trends in injured workers in TN. Additionally, we will look for new ways to use these data sources to identify illnesses and events caused by opioid use. |
| 11. Opioid and benzodiazepine prescribing patterns during pregnancy in TN | Opioid use among women of reproductive age has increased in recent years in the United States, with some of the highest use observed in southeastern states and among women of lower |

| | |
|---|---|
| | socioeconomic status. The primary objective of this analysis is to describe use of opioids and benzodiazepines, including type, duration, and dose during pregnancy and in the first three months postpartum, considering pre-pregnancy use. The study will utilize TN vital statistics and CSMD data. |

## Population Highlight: Understanding the Role of Prescription History in Overdose Deaths to Identify Individuals at Risk

Lead Analyst: Sarah Nechuta, MPH, PhD

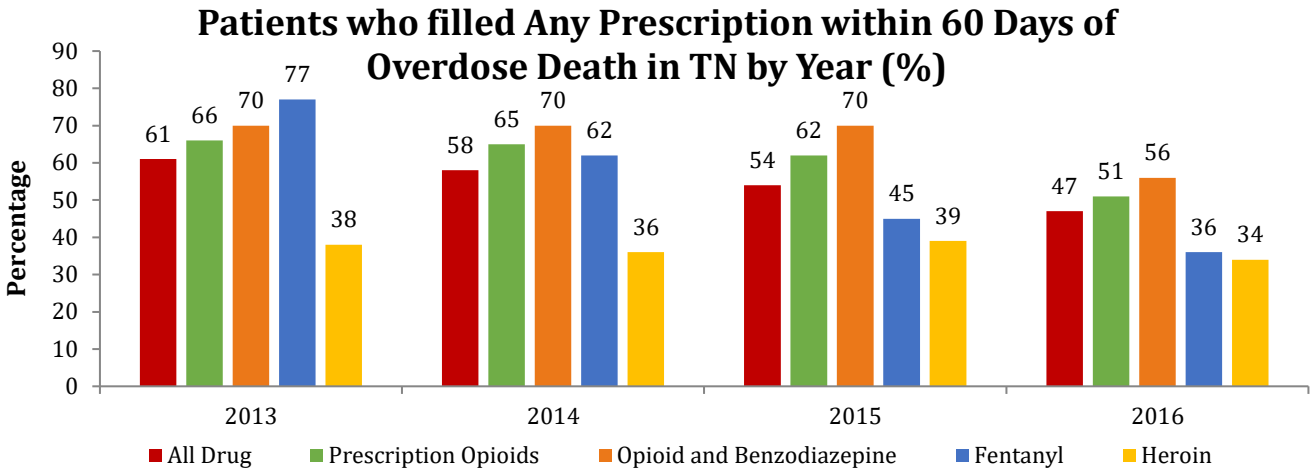
### Introduction

All drug overdose deaths[43] continue to increase in TN with elevations observed regardless of sex and race. Substantial increases in overdose deaths have been observed in recent years for fentanyl (largely due to illicitly manufactured fentanyl) and heroin. Risk factors for deaths may be different depending on contributing substances. Understanding prescription history among Tennesseans who have died of a drug overdose overall and by type of contributing substance can provide important insights for prevention and intervention.

We have conducted analyses to understand the role of prescription history in overdose deaths among TN adults. We summarize here (1) results on filled prescriptions in the 60 days before overdose death and (2) characteristics of opioid overdose decedents in 2013 and 2016 by filled prescription history in the 60 days before death. This analysis utilized linked CSMD and TN death statistical file data for all drug overdose deaths among TN residents during 2013 to 2016 (n=5,511).

### Results Summary: Prescription History in the 60 Days before Overdose Death in TN (2013-2016)[44]

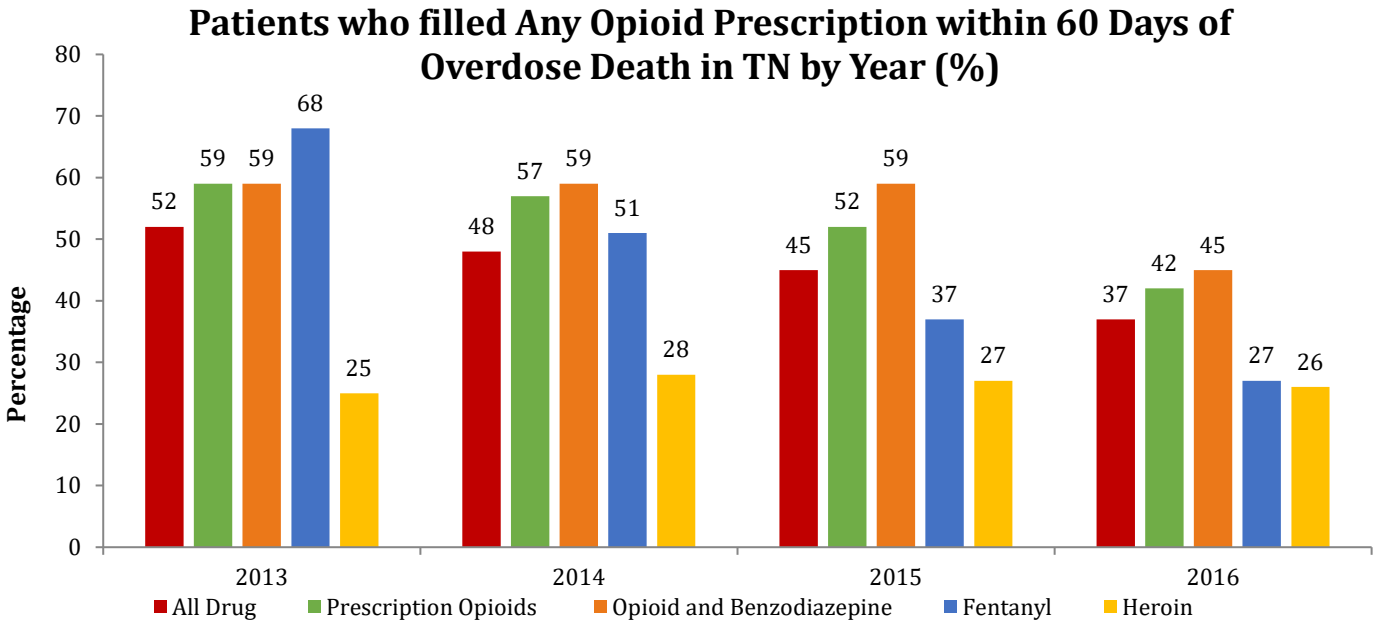
Among all drug overdose deaths during 2013 to 2016 (n=5,511), we evaluated prescription history in the CSMD in the 60 days before death for any, opioid and benzodiazepine prescriptions among TN overdose decedents. As shown below, among all drug overdose decedents, 61% filled a prescription in the CSMD within 60 days of their death in 2013, and this proportion has decreased over time to 47% in 2016. The proportion with prescription fills within 60 days of death among individuals who died of heroin overdoses slightly decreased during 2013 and 2016 (38% to 34%). However, the proportion of individuals who died of a fentanyl overdose with a prescription fill within 60 days of death substantially decreased from 77% in 2013 to 36% in 2016.



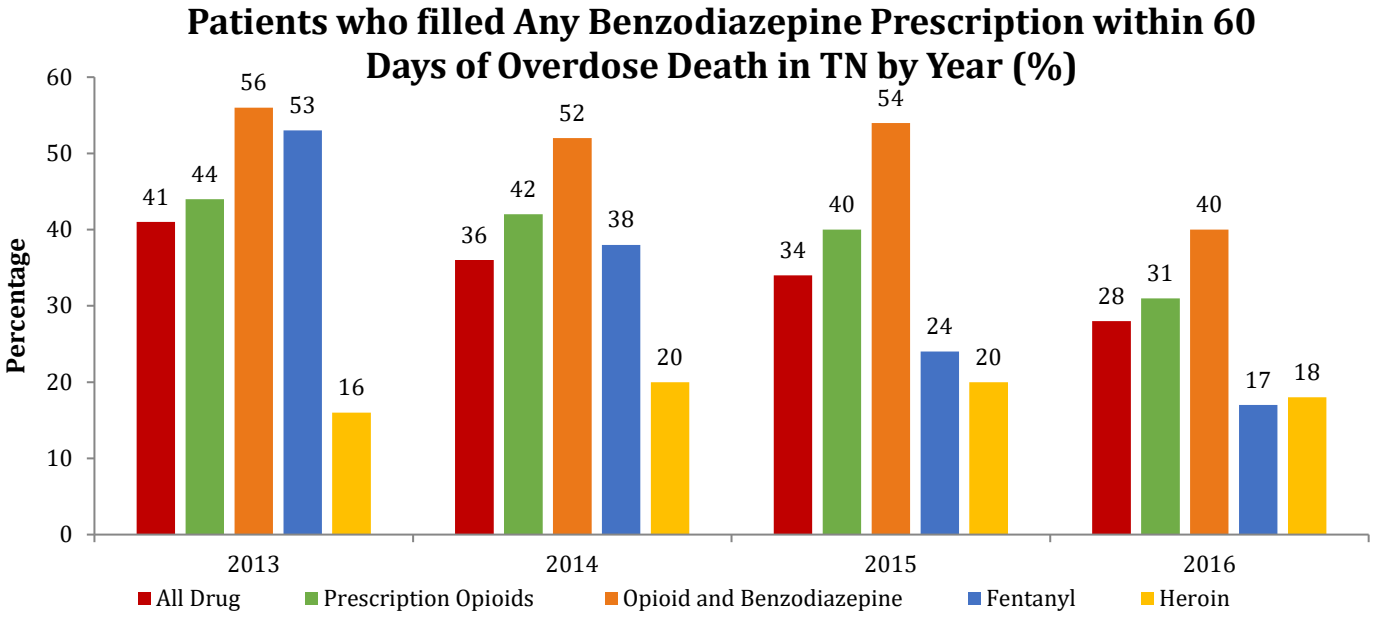

Analysis by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data sources: TN death statistical files, Controlled Substance Monitoring Database.

[43] Drug overdose deaths caused by acute poisonings. Defined using ICD-10 codes: X40–X44; X60-X64; X85; Y10-Y14.
[44] See Appendix E7. Prescription History in the CSMD among All Drug Overdose Deaths for additional related data.

As shown below, among all drug overdose decedents, the percent who filled an opioid prescription decreased from 52% in 2013 to 37% in 2016. Decreasing percentages for individuals having filled a prescription in the 60 days before death during 2013 to 2016 were also seen for opioid overdose deaths, prescription opioid deaths, fentanyl, and methadone, with the largest decrease for fentanyl overdose deaths (68% in 2013 to 27% in 2016).




Analysis by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data sources: TN death statistical files, Controlled Substance Monitoring Database.




Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data Source: TN death statistical file, Controlled Substance Monitoring Database.

**Results Summary: Characteristics of Individuals Who Died With and Without a Prescription in the CSMD in the 60 Days before Death**

Characteristics of All Drug Overdose TN Decedents by Prescription History in the 60 Days Before Death, 2013 and 2016

| | Opioid Prescription Filled | | | | Benzodiazepine Prescription Filled | | | |
|---|---|---|---|---|---|---|---|---|
| | 2013 | | 2016 | | 2013 | | 2016 | |
| | Yes (n=606) | No (n=560) | Yes (n=608) | No (n=1023) | Yes (n=474) | No (n=692) | Yes (n=454) | No (n=1177) |
| **Age at death, %** | | | | | | | | |
| <18 | 0 | 0.9 | 0 | 0.5 | 0 | 0.7 | 0 | 0.4 |
| 18-24 | 2.6 | 8.2 | 1.6 | 10.2 | 1.7 | 7.8 | 2.6 | 8.7 |
| 25-34 | 11.1 | 23.1 | 14.3 | 24.9 | 11.0 | 20.9 | 12.8 | 24.1 |
| 35-44 | 25.4 | 22.4 | 19.4 | 22.4 | 24.5 | 23.6 | 22.3 | 20.9 |
| 45-54 | 32.3 | 26.0 | 33.7 | 25.4 | 34.8 | 25.5 | 35.0 | 26.0 |
| 55-64 | 22.0 | 14.9 | 23.4 | 13.3 | 21.7 | 16.4 | 20.9 | 15.6 |
| ≥ 65 | 6.6 | 4.5 | 7.6 | 3.3 | 6.3 | 5.1 | 6.4 | 4.3 |
| **Race, %** | | | | | | | | |
| White | 93.9 | 87.3 | 92.4 | 86.1 | 97.3 | 86.3 | 95.2 | 85.9 |
| Black | 6.0 | 12.3 | 7.4 | 13.0 | 2.8 | 13.3 | 4.9 | 13.3 |
| Other | 0.2 | 0.4 | 0.2 | 0.9 | 0 | 0.4 | 0 | 0.9 |
| **Gender, %** | | | | | | | | |
| Male | 51.0 | 57.3 | 48.4 | 64.0 | 46.8 | 59.0 | 43.6 | 63.8 |
| Female | 49.0 | 42.7 | 51.6 | 36.0 | 53.2 | 41.0 | 56.4 | 36.2 |
| **Marital Status, %** | | | | | | | | |
| Married | 31.7 | 27.5 | 28.7 | 20.9 | 29.9 | 29.4 | 32.5 | 20.4 |
| Divorced/separated | 41.6 | 32.2 | 41.6 | 31.7 | 42.5 | 33.3 | 41.0 | 33.2 |
| Never married | 20.1 | 35.3 | 21.8 | 41.9 | 19.7 | 32.7 | 19.2 | 40.3 |
| Widowed | 6.6 | 5.1 | 7.9 | 5.6 | 7.8 | 4.6 | 7.4 | 6.1 |
| **Education, %** | | | | | | | | |
| < High school diploma | 25.8 | 24.6 | 27.1 | 24.4 | 24.3 | 25.8 | 25.8 | 25.3 |
| High school | 47.6 | 47.2 | 47.6 | 46.8 | 46.1 | 48.3 | 46.2 | 47.4 |
| Some college | 20.9 | 18.8 | 19.5 | 20.9 | 23.0 | 17.8 | 19.6 | 20.8 |
| ≥ College graduate | 5.7 | 9.4 | 5.8 | 7.9 | 6.6 | 8.1 | 8.4 | 6.6 |
| **Intentionality, %** | | | | | | | | |
| Unintentional | 85.2 | 83.0 | 86.4 | 90.7 | 82.3 | 85.4 | 84.4 | 90.9 |
| Suicide | 7.6 | 10.2 | 9.4 | 6.6 | 9.5 | 8.4 | 10.1 | 6.6 |
| Homicide | 0.2 | 0.2 | 0 | 0.1 | 0 | 0.3 | 0 | 0.1 |
| Undetermined | 7.1 | 6.6 | 4.3 | 2.6 | 8.2 | 5.9 | 5.5 | 2.4 |

Table excludes missing. Limited to all drug overdose deaths to TN residents, 2013 and 2016. Data sources: TN death statistical files, Controlled Substance Monitoring Database.

The table above displays characteristics of all drug overdose decedents in TN for 2013 and 2016 by prescription history in the 60 days before death. For opioid prescriptions, fill status varied by demographics and intentionality. For example, in 2013, a higher proportion of those who did not fill an opioid prescription were younger (18-24 and 25-34 year-olds), while a lower proportion of those who did not fill an opioid were older (35 years old and above). A similar pattern was observed for benzodiazepine prescriptions in both 2013 and 2016. The proportion of male decedents who did not fill an opioid prescription in the 60 days before death increased from 57.3% in 2013 to 64.0% in 2016.

**Future Work**

We have developed methodology to conduct comprehensive analyses of prescription history in the year before overdose death, including timing of prescriptions (days before overdose death, active prescriptions at overdose death) and type of prescriptions, which can be quickly updated as needed. Overdose death-related risk measures, included demographics, prescription history in the CSMD, and characteristics of decedents who diverted prescription substances at death can guide targeted prevention and intervention efforts in TN. Incorporation of additional data, for example, history of non-fatal drug overdoses and opioid-related hospital discharges among drug overdose decedents is in progress and will provide further targets for intervention.

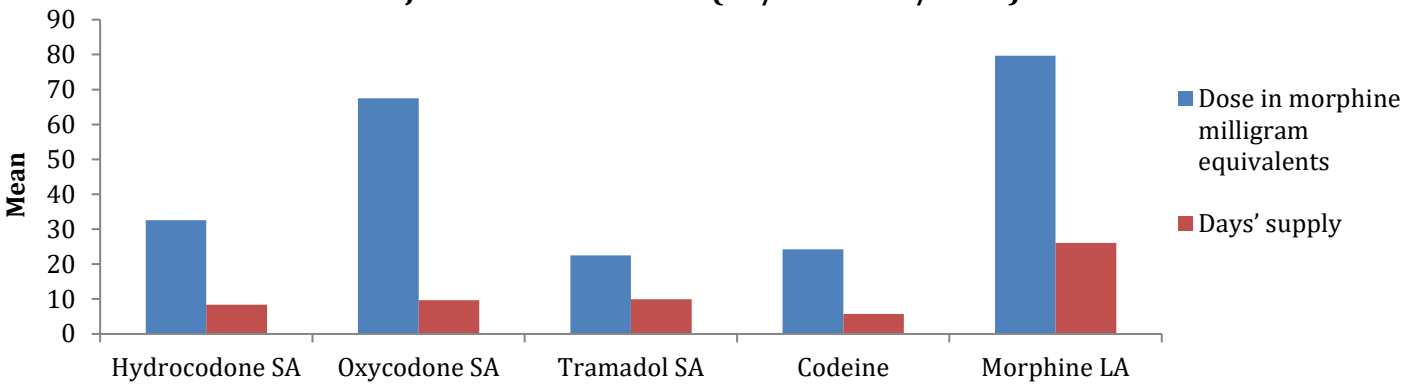
## Population Highlight: Prescription Opioid Use among Injured Workers in TN

Lead Analyst: Zoe Durand, MPH

As part of our collaboration with the Bureau of Workers' compensation, we conducted a cohort study using linked statewide databases to describe opioid use for pain by injured workers in TN.

Opioid use for pain is high in injured workers in TN with one in five receiving an opioid within one week of injury and one in three receiving an opioid within six months of injury. Opioid use is spread across sexes and regions of TN. The strongest predictor of opioid use after injury is opioid use prior to injury, but after this is controlled for the groups most likely to receive opioids for pain are workers with fractures, sprains, strains, or tears, and lower back injuries, and workers older than 35 years. The five most commonly prescribed opioids for pain were hydrocodone short-acting (58% of prescriptions), oxycodone short-acting (20%), tramadol short-acting (16%), codeine (2%), and morphine long-acting (0.8%). It appears prescribers treating injured workers generally follow prescribing guidelines, as mean doses are well below 120 morphine milligram equivalents and mean days' supplies are below 30 days.

**Prescription Characteristics for the Top Five Prescribed Opioids for Pain to Injured Workers in TN (01/2013 - 06/2015)**




A second product of our collaboration with Workers' Compensation is a predictive model for injury as a gateway to long-term opioid use. Injury has been documented as an entry point to long-term opioid use in previously opioid-naïve workers, causing increased risk of opioid-related side effects and higher expenses for the worker and their employer. The Centers for Disease Control defines long-term opioid use as receiving an opioid for most days in a 90 day period,[45] but definitions used in occupation health research are varied and often include much longer time frames.[46] We are using analyses of the timing of opioid use in TN injured workers to evaluate which definition is most appropriate for this population, and then apply it to build a predictive model identifying groups that may have increased likelihood of becoming long-term opioid users.

[45] Dowell D, Haegerich TM, Chou R. CDC Guideline for Prescribing Opioids for Chronic Pain - United States, 2016. MMWR Morb Mortal Wkly Rep. 2016 Mar 18;65(1):1-49.

[46] Franklin GM, Rahman EA, Turner JA, Daniell WE, Fulton-Kehoe D. Opioid use for chronic low back pain: A prospective, population-based study among injured workers in Washington state, 2002-2005. Clin J Pain. 2009;25(9):743-751; Heins SE, Feldman DR, Bodycombe D, Wegener ST, Castillo RC. Early opioid prescription and risk of long-term opioid use among US workers with back and shoulder injuries: a retrospective cohort study. Inj Prev. 2016;22(3):211-215; Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. Spine (Phila Pa 1976). 2007;32(19):2127-2132.

## Population Highlight: Prescription Opioid Use and Neonatal Abstinence Syndrome in TN

Lead Analyst: Sarah Nechuta, MPH, PhD

### Introduction

Neonatal abstinence syndrome (NAS) is a group of health conditions that can occur during withdrawal due to in utero drug exposure, and in particular opioids. As of 2013, NAS is a mandatory reportable condition in Tennessee.[47] Currently 3 other states require reporting NAS.[48] Two large population-based studies have evaluated opioid dose and type in association with NAS, but both were among Medicaid only populations.[49] To our knowledge, no study has evaluated the role of opioid use in association with NAS using Prescription Drug Monitoring Program (PDMP) Data.

**Study Objective:** To evaluate opioid dose, timing, and type based on CSMD dispensed prescription records in association with NAS using linked Tennessee (TN) statewide datasets.

**Study Design**: Retrospective cohort study using linked state-wide TDH data among women who gave birth in TN during 2013-2014 and filled ≥1 opioid prescription during pregnancy (n=22,328).

**Results Summary:**

| | Overall Cohort |
|---|---|
| Buprenorphine for MAT, % | 8.0 |
| Hydrocodone, % | 64.5 |
| Oxycodone, % | 17.3 |
| Tramadol, % | 7.1 |
| Codeine, % | 23.8 |
| Short acting opioid, % | 94.5 |
| Long acting opioid, % | 9.1 |
| 3rd trimester opioid use, % | 45.6 |
| Chronic use (≥30 days), % | 19.0 |
| Benzodiazepines, % | 9.0 |

Prescription data was based on dispensed prescriptions from the CSMD. As shown in the table to the left, about 94.5% of the cohort used a short-acting opioid and 9.1% used a long-acting opioid. Among women who delivered a NAS infant, 25.2% filled 1 or more prescriptions for a benzodiazepine (compared to 9.0% for the overall cohort).

The prevalence of NAS was 18.5% among women who used buprenorphine for medication-assisted treatment. Among women who used only opioid analgesics ≥30 days during pregnancy the prevalence was 4.7%. A higher proportion of women with a NAS infant were of lower education, lower income, and of White race, compared to women without a diagnosis of a NAS infant. In the cohort, a higher proportion of women with a NAS infant smoked during pregnancy and did not receive prenatal care or initiated prenatal care later in pregnancy compared to women without a diagnosis of a NAS infant in TN. A higher proportion of infants with a diagnosis of NAS were preterm (< 37 weeks), male, and of low birthweight (<2500 grams), compared to infants without a diagnosis of NAS in TN.

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[47] Implementation of a statewide surveillance system for neonatal abstinence syndrome - Tennessee, 2013. Warren MD, Miller AM, Traylor J, Bauer A, Patrick SW; Centers for Disease Control and Prevention (CDC). MMWR Morb Mortal Wkly Rep. 2015 Feb 13;64(5):125-8).

[48] Ko JY, Patrick SW, Tong VT, Patel R, Lind JN, Barfield WD. Incidence of Neonatal Abstinence Syndrome - 28 States, 1999-2013. MMWR Morb Mortal Wkly Rep. 2016 Aug 12;65(31):799-802.

[49] Patrick SW et al. Prescription opioid epidemic and infant outcomes. Pediatrics. 2015 May;135(5):842-50; Desai RJ, et al. Exposure to prescription opioid analgesics in utero and risk of neonatal abstinence syndrome: population based cohort study. BMJ. 2015 May 14;350:h2102.

Higher total prescription opioid dose was associated with increased diagnoses of NAS in the full cohort, adjusting for maternal and infant characteristics. Specifically, the odds of having an infant with NAS were 14 times greater for women with the highest dose during pregnancy compared to women with the lowest dose. The strength of association for increasing dose and increasing NAS was stronger for use in the third trimester. While NAS was more common among women using buprenorphine for MAT, increasing opioid dose was not associated with increased NAS diagnoses among women using buprenorphine for MAT during pregnancy.

**Future Work**

We are conducting additional analyses to include updated outcome and prescription data. When evaluating the public health implications for opioid use during pregnancy, it is important to consider other adverse outcomes that can impact both maternal and child health. We are evaluating the association of prescription opioid use during pregnancy and other birth outcomes of public health significance, including very preterm and preterm birth among TN infants. The updated study will also include an evaluation of opioid and benzodiazepine use patterns and characteristics of users during and around pregnancy. The risk measures identified in the completed analyses to date, as well as future additional risk measures determined in future analyses, can be used to identify at risk women for prevention and intervention in TN.

## Population Highlight: The Effect of Ending Direct Dispensing in Pain Clinics

Lead Analyst: Jackie Yenerall, PhD

### Introduction

In 2013 the Tennessee legislature passed Public Chapter 336 which prohibits doctors, nurses, and physician assistants working at a pain management clinics from directly dispensing controlled substances. Special attention is often paid to pain management clinics because of the role they are believed to play in diverting prescription opioids to the black market, especially when they develop into pill mills, which are clinics or prescribers that are prescribing or dispensing controlled prescription drugs inappropriately.

Thus, laws directed at pain clinics are designed to deter the development of pill mills and limit the supply of prescription opioids either by directly or indirectly influencing prescriber behavior and could reduce the number of prescriptions for opioids, or change the attributes of those prescriptions (i.e. days' supply or strength).

### Study Objective

The purpose of this study is to determine what, if any, effect the law had on pain management patients' supply of opioids.

### Study Design

Data for this project comes from the CSMD. Since PC336 was passed in April 2013 and enacted on July 1, 2013 data will be included from July 1, 2012 until July 31st, 2014 to include one year of baseline data and one year post policy. Only prescriptions for opioids will be included in the analysis. Data was analyzed at the patient-month unit of observation.

In order to better identify opioid users who are more likely to be patients of pain management clinics, the following inclusion criteria were used: patients must have had a least two months of observations with at least one month prior to the enactment of the policy, patients with birthdates prior to 1913 were excluded, prescriptions with a days supply of 0 or greater than 180 were excluded, and prescriptions for buprenorphine used for medication assisted therapy were excluded.

An interrupted time series analysis (ITS) model will be used to identify the causal effect of the law. ITS is a method utilized in policy evaluation when a control or comparison is not readily available and relies upon the trends estimated prior to the implementation of the policy (the baseline time periods) to serve as the control for secular trends in the post policy implementation periods. Outcomes for this model will include number of monthly prescriptions, average days supply, and average morphine milligram equivalents. Jointly these outcomes capture changes in a patient's prescription opioids supply.

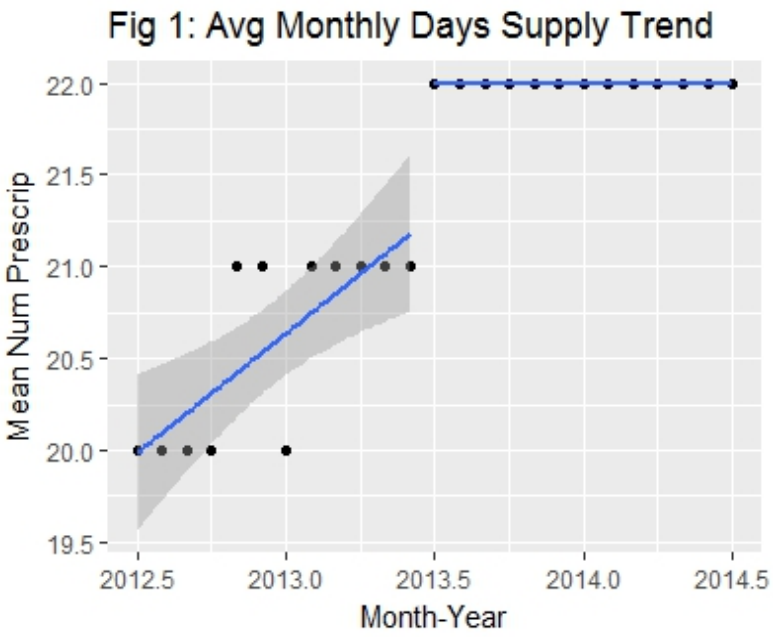
### Results Summary

The below table shows summary statistics describing the sample during the baseline period. The individuals included in the study are predominately female, and the average age was 50. On average, individuals were observed for 4 months during the baseline period and filled an average of 6 prescriptions. The most common method of payment type was private commercial insurance, followed by Medicare and Medicaid.

Figure 1 shows the change in the average monthly days supply over the entire observation period. A discrete break is observed in the trend around May 2013, which is several months prior to the enactment of PC336 but one month after it passed, which could suggest that prescribers changed their behavior in anticipation of the change in law but this will have to be further explored in a regression model.

Baseline Summary Statistics

| | | |
|---|---|---|
| Age, mean (SD) | 50.04 | (18.34) |
| Female, n (%) | 58.81 | (49.22) |
| Male, n (%) | 41.07 | (49.20) |
| Num. Prescriptions, mean (SD) | 5.98 | (6.63) |
| Num. Month, mean (SD) | 4.25 | (3.61) |
| Prescriptions per month, mean (SD) | 1.30 | (0.53) |
| Days supply per prescription, mean (SD) | 15.73 | (13.32) |
| Payment Type, | | |
| Medicaid | 13.70 | (32.28) |
| Medicare | 15.81 | (34.66) |
| Commercial Insurance | 51.36 | (46.14) |




**Future Work**

The next stage of this analysis is to estimate the ITS model for the outcomes of interest to identify the potential casual effect of the change in policy

# Data-driven Support for Licensure and Over-Prescribing Investigations

A primary tool that TDH has in the opioid epidemic is the ability to maximize likelihood that prescribing is appropriate, with interventions ranging from education to disciplinary actions like license revocation. The Office of General Counsel (OGC) brings actions against prescribers based on investigations that have typically been driven by external complaints. Lawyers in OGC have access to the CSMD, but have typically had to pull records one by one to develop a file that represents the prescribing pattern of a particular prescriber, or the history of a particular patient. Furthermore, they have depended on external complaints to identify prescribers who may be engaging in high risk clinical practices.

Development of the integrated data system and data warehouse is the basis for the PDO team to develop a series of query tools and risk models to a) increase efficiency of investigations by allowing investigators to pull CSMD data that has been subjected to our data cleaning protocols, sort and search it in order to identify which charts to pull in an investigation and b) use data driven models to identify prescribers who may be at high risk due to their overall prescribing patterns and patient outcomes, regardless of complaint status.

The "search and sort" tool is based on a SQL process that produces an excel pivot table with the specifications set by the investigator that can be modified to pull increasingly granular data. For example, an investigator may request information on all prescriptions by a certain prescriber or group of prescribers in a given timeframe, then modify that request to limit and sort the table by factors including types of drugs, characteristics of patients (e.g. age), prescription factors such as MME or number of prescriptions. They can thus identify within minutes a prescriber's patients with, for example, the highest MME or greatest number of overlapping prescriptions and determine whether the pattern suggests that further investigation is warranted. Prior to development of the integrated data system, there was no way to connect to a database in this way that would allow the investigators to use the data quickly and directly without an intermediary pulling records for them. The investigators and lawyers using the tool report that it has significantly increased efficiency and that it bolsters confidence in their understanding of the data patterns.

In 2018, we are developing a series of high risk indicators for a priori identification of prescribers with concerning prescription patterns. To date we have identified 8 potential indicators. In the first quarter of 2018, those will be validated, weighted, and a model developed to rank risk level, thus identifying in rank order practices of concern. Decisions will be made about types of prescribers to exclude from modeling as information about prescriber specialty is improved in the database. Risk model information will be incorporated into a protocol being developed to guide and target investigations that incorporates both data driven and complaint information and processes. It will also be incorporated into a dashboard that will update quarterly for the OGC. Elements of the risk indicators include, among others:

- High concentration of patients at high levels of daily MME
- Number of prescriptions and prescriptions per patients
- High numbers of patients with overlapping benzodiazepine and opioid prescriptions
- High numbers of patients on chronic opioid use
- High numbers of patients who engage in doctor shopping
- Patients who experience an overdose death while on active prescription

# County-Level Data Dissemination

***Overview***

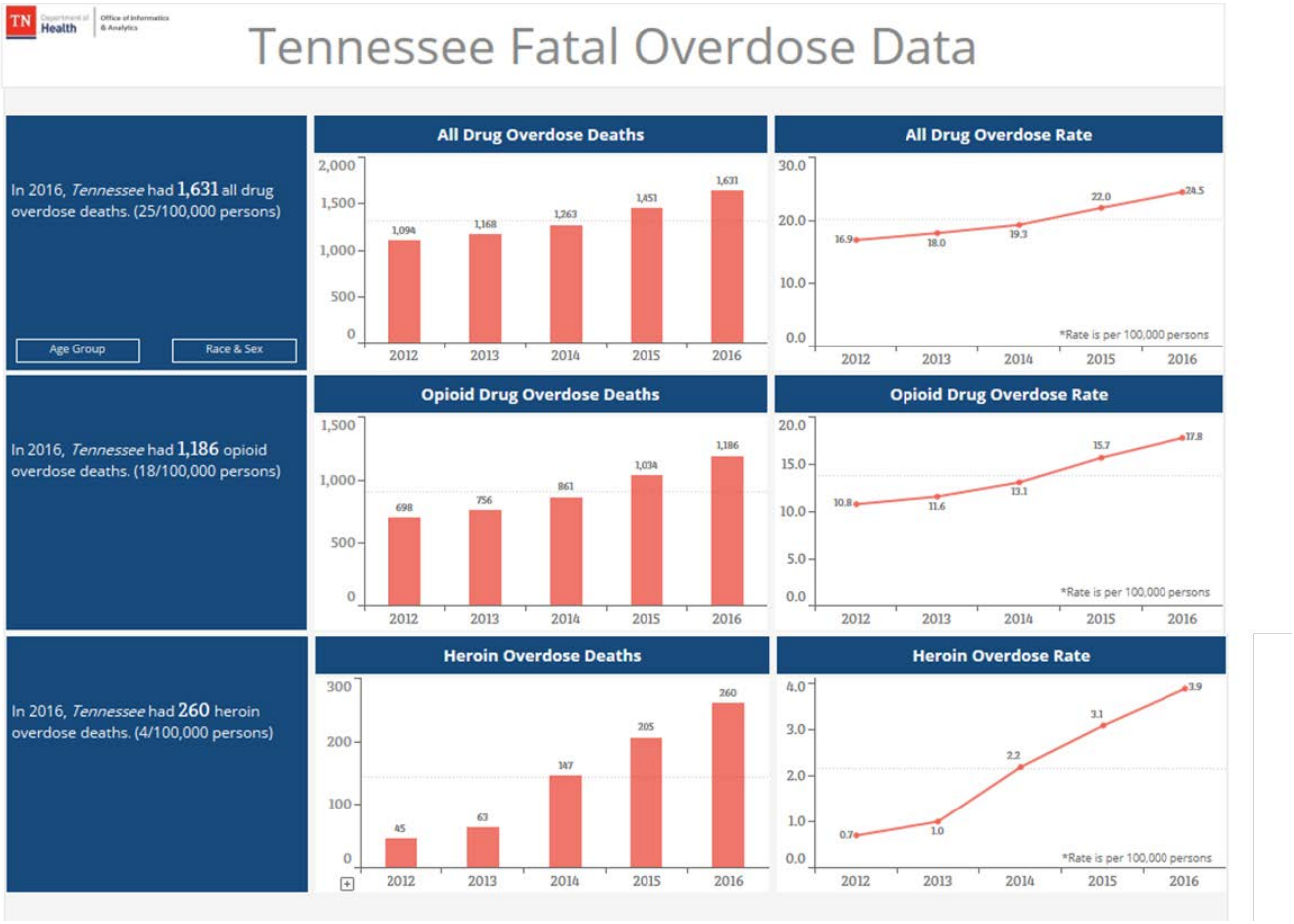
A key goal of the PDO team is to disseminate data to communities that is relevant, timely and usable. Building on the data systems that we developed, the team added several members to our grant to fulfill the role of translating and disseminating data and educational materials. In November of 2016, our team attended a statewide meeting of anti-drug coalitions working to reduce dependence on harmful and potentially lethal substances such as prescription drugs, alcohol, and tobacco (Appendix E8). The directors of these coalitions reiterated the urgent need for local-level data to inform coalition participants, community members, healthcare providers, local public health workers and policymakers. Therefore, a plan was developed to launch a series of communication tools, including a website, data briefs for every county, a catalogue of slide sets to be made widely available and a dashboard allowing data to be presented at the state, regional and county levels. We based our plan on the PDO tagline, *"Numbers count. Every number is a story. Every story is a person."* and the philosophy that the role of this group is to reunite communities with their own data.

***Data Briefs***

In July 2017, two-page data briefs were completed for each of Tennessee's 95 counties. These county-level data briefs provide the numbers and rates of fatal and non-fatal drug overdoses for 2015, in the context of the region or the State. Moving forward, county-level data briefs will be updated annually and expanded to include additional indicators. The process for their development will be automated in the HEW.

***Dashboard***

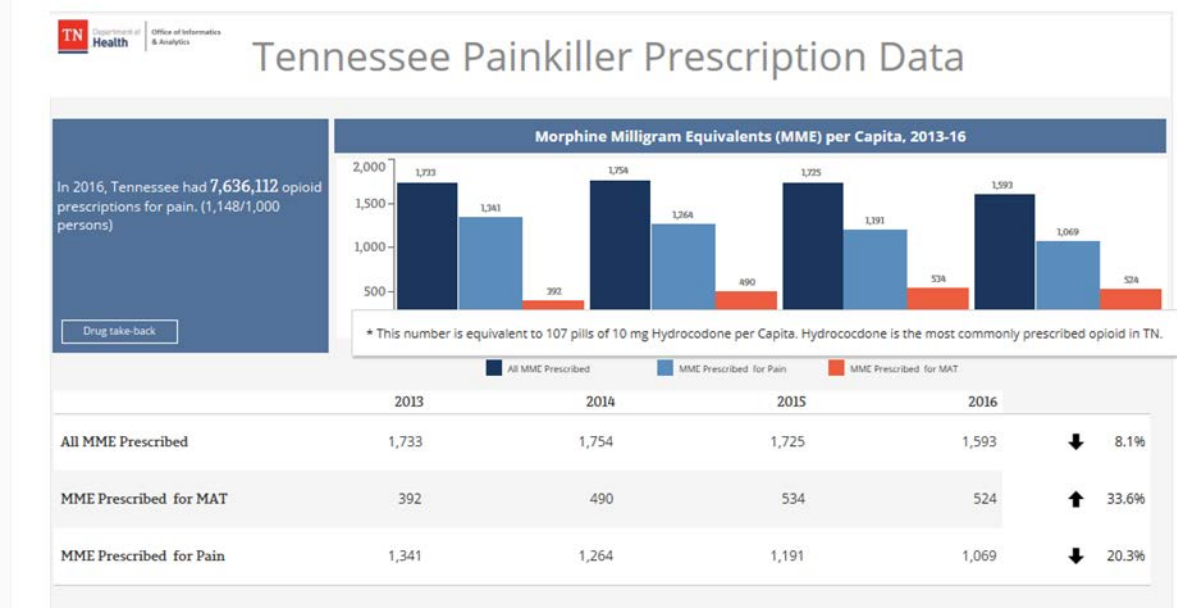
The Drug Overdose Data Dashboard was released on August 8, 2017, making indicators available to anyone with Internet access and a device such as a computer, laptop, tablet, or smart phone. The Tennessee Drug Overdose Dashboard provides accurate county, regional and state-level indicators including: fatal drug overdoses (see dashboard screenshot *Tennessee Fatal Overdose Data*), non-fatal drug overdoses and drug prescribing. New indicators are being added in updated versions of the dashboard, and the entire system will be automated in the HEW as we move forward, enabling quick data updates as new data are obtained. In particular, the analytic developments described elsewhere in this report have enabled the use of an increasing number of indicators that will be drawn from continuously evolving PDMP (CSMD) data.




Since August, the TDH-OIA has provided dashboard training and technical assistance to more than 300 individuals from anti-drug coalitions, healthcare providers, the Tennessee Prevention Alliance and other community outreach organizations. In the first three months, (August 8, 2017- October 31, 2017), there were approximately 3,639 page views of the dashboard's main page. In addition to webinars, TDH-OIA staff members have travelled statewide, providing communities with training and technical assistance. We have presented in libraries, churches, local health departments, and storefronts. A detailed list of dashboard presentations can be found in Appendix F.

At the beginning of our dashboard training, the presenter awards audience members with bags of candies. The significance of the candies is revealed when the presenter shares that there are 107 pieces of candy in the bag representing 107 pills of hydrocodone 10mg, reflective of the current average volume of painkillers dispensed in TN (see the dashboard screenshot *Tennessee Painkiller Prescription Data*). The audience members ask, "What about my county?" All 95 counties are available for viewing on the dashboard, with a range of 42 to 317 "pills" per person. In trainings, additional bags of candies representing pills per respective counties have also been given to some audience members. Inevitably, audience members are most interested in learning more about the prescribing practices in their communities. As it is revealed what the distributed bags of candies represent, audience members, who have already shared their bags of candies, have a tangible example of how easily drug diversion can occur. When one audience member has been provided 107 candies, that person is more than willing to

share generously with his or her neighbor. This candy sharing behavior has logically extended to a useful analogy for the sharing of opioids as well.




User feedback from the Tennessee Drug Overdose Dashboard has been extremely positive. Users have stated that they are utilizing the dashboard information in grant-writing, for other presentations in their communities, and for treatment planning in their region. As the *candies as pills* example has tracked with communities, some coalitions are implementing their own model and have contacted TDH-OIA to use this example in their local presentations. The dashboard will continue to improve as additional indicators and updates are implemented in 2018.

### *Slide Catalogue*

Another common request for this team both from internal and external stakeholders has been for presentation support. We have curated a series of more than 430 slides that can be made publicly available, a subset of which are available to public health professionals currently through a SharePoint site. Slide sets for individual counties are developed and have been made available to coalitions and county health directors for their use. Technical assistance in interpreting and using the slides is available. Overall, this effort will support communication at the community level and reduce misinformation.

### *Website*

Finally, development of a focused website to allow easy access to these materials was completed in August 2017 and it can be found here: https://www.tn.gov/health/health-program-areas/pdo.html. The website also includes annual data reports with county level data, contact information, analytic project descriptions, onboarding instructions for hospitals and emergency departments reporting drug overdoses and patient brochures for targeted patient groups, including surgical patients, women who may be pregnant, adolescents and the elderly.

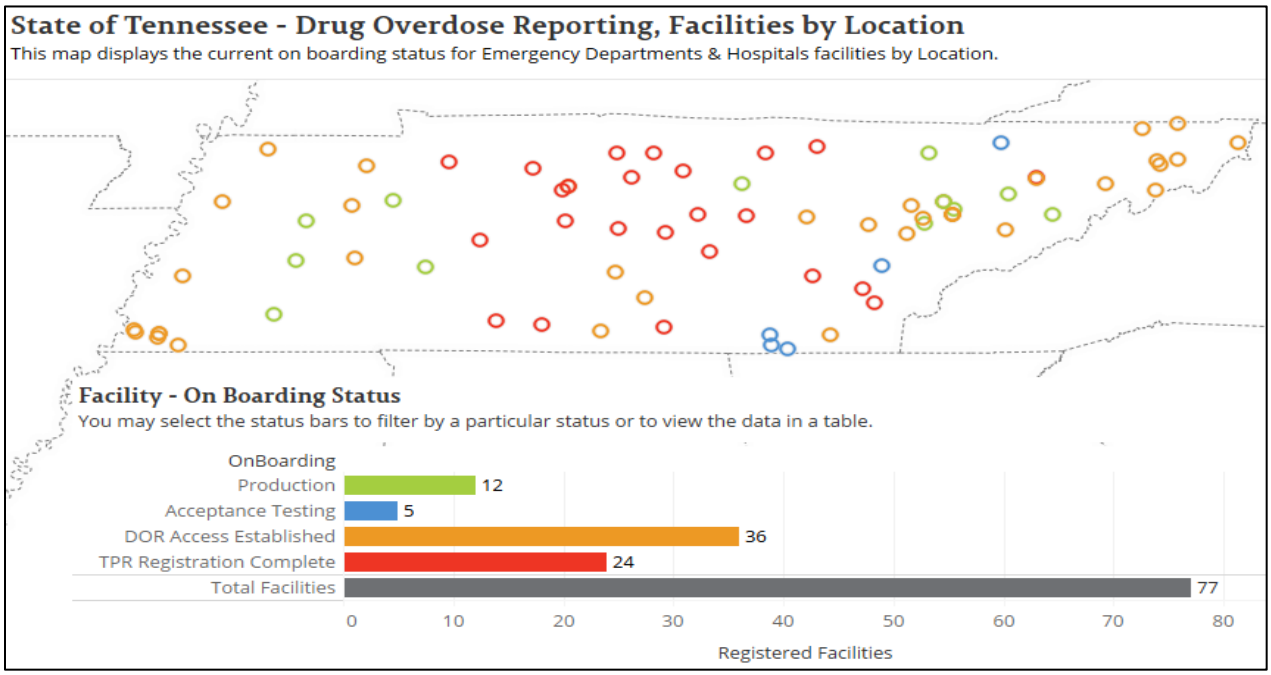
# Drug Overdose Reporting

The TDH, through the OIA, are implementing statewide Drug Overdose Reporting (DOR). OIA has developed a data capture application that allows Emergency Departments & Hospitals to electronically upload DOR data files directly to TDH. OIA has created the necessary documentation explaining the data requirements, onboarding milestones and data upload procedures. As a quality assurance measure OIA has developed and implemented automated data validation rules that are performed on all data submitted for Drug Overdose Reporting. TDH also has developed a Drug Overdose Reporting website[50] to communicate and share all of the DOR related documentation and instructions.

On August 15, 2017 OIA opened enrollment for all Emergency Departments & Hospitals to register and onboard with the goal to have all Emergency Departments & Hospitals electronically transmitting Drug Overdose Reporting data on a weekly basis by March 31st 2018 (TDH Announcement Letter[51]). TDH has communicated the Drug Overdose Reporting requirements to hospitals through multiple channels, including direct email communication, and publications in organizational newsletters:

- Tennessee Hospital Association newsletter
- TennCare HER newsletter
- East Tennessee Health Information Network
- Rural Health Association of Tennessee newsletter

As of December 15th, TDH has Registered 77 Emergency Departments & Hospital Facilities. The map below provides a visual distribution of the registered facilities by location throughout the State of TN. The bar chart indicates the number of facilities in each of the 4 onboarding statuses as of 12/13/2017.




[50] https://www.tn.gov/health/health-program-areas/pdo/pdo/drug-overdose-reporting.html
[51] https://www.tn.gov/content/dam/tn/health/documents/DOR_Commissioner_ltr.pdf

# Enhanced State Opioid Overdose Surveillance Grant

The Enhanced State Opioid Overdose Surveillance (ESOOS) Grant, awarded to the TDH by the Centers for Disease Control and Prevention, has the main goal of improving the surveillance of both non-fatal and fatal overdoses related to opioids. Additionally, ESOOS funding made available to states is intended to improve the timeliness of fatal overdose reporting to the State Unintentional Drug Overdose Reporting System (SUDORS). By establishing a surveillance practice for non-fatal overdoses and by improving the timeliness of fatal overdose reporting, states receiving ESOOS funding can better respond to the opioid epidemic.

In Tennessee, the ESOOS grant covers three domains: improving non-fatal overdose surveillance; establishing a system for reporting overdose-related deaths to the SUDORS system (Tennessee is not a state that participates in the National Violent Death Reporting System, where SUDORS is housed); and developing a data-dissemination strategy that allows for stakeholders at the community, agency, and leadership levels to get actionable data points to drive the response to the opioid epidemic. Each of these components requires the OIA to reach out and form meaningful relationships with community stakeholders, other state programs, and national partners to achieve meaningful outcomes.

Improving non-fatal overdose surveillance is largely dependent on the DOR process, which is discussed in more depth above in the **Drug Overdose Reporting** section. The DOR data is being compared to national syndromic surveillance data in order to better attenuate our data requirement guidelines for trading partners, and also to serve as a validity measure for this process.

Fatal overdose surveillance involves a strong working relationship with the Medical Examiner's Office in the central office of the health department, county medical examiners, and other groups within the department of health that handle vital statistics and death data. A large component of this grant is assisting the Medical Examiner's office in their transition to an electronic death record reporting system that ESOOS staff will access to abstract overdose death data for reporting to SUDORS. The abstraction process from an electronic system should greatly improve the timeliness of overdose death reporting, achieving one of the primary goals of the ESOOS grant.

The OIA group members working on the ESOOS grant are also actively engaging with agency and community stakeholders to ascertain data elements that would be useful for dissemination, and are actively working to generate appropriate 'level' reports that can be sent to community partners, internal partners, and leadership groups for effective decision making. These reports, as well as planned community meetings around the state, address the dissemination strategy outlined in the ESOOS work plan.

# Hal Rogers Grant Progress Summary

The TDH was awarded the Harold "Hal" Rogers Prescription Drug Monitoring Program: Data-Driven Responses to Prescription Drug Abuse Grant in September 2016 by the Office of Justice Programs under the US Department of Justice. The primary purpose of the Harold Rogers PDMP is to enhance the capacity of regulatory and law enforcement agencies and public health officials to work together to collect and analyze controlled substance prescription data and other scheduled chemical products through a centralized database administered by an authorized state agency. Through this grant the TDH is enhancing the existing collaboration between TDH, the Tennessee Bureau of Investigation [TBI] and the Tennessee Department of Mental Health and Substance Abuse Services [TDMHSAS] to better understand the progression from drug use to drug abuse to drug addiction in the state of Tennessee. This grant will also give the team the ability to pool resources and identify abuse trends and "hot spots" of activity within the state. By utilizing data sources and sharing key data from all three organizations, and collaborating with community coalitions, we will be able to target our efforts to areas of need with a focused rapid response team. This team will be able to connect with individuals who are at risk of diverting prescription drugs or transitioning to illicit drugs and recommend or deliver treatment. With the information provided to the team they will be able to focus their efforts on where interventions are most necessary.

Future goals are to provide direct electronic access to the CSMD for law enforcement officials and drug courts. The current manual process will be updated and CSMD reports will be available and delivered by a secure electronic system. This will shorten times between requests and receipt of pertinent information that law enforcement needs in order to execute official duties. Another goal is to recruit health care practitioners who will train and lead experts in the field to deploy rapid response teams to educate, treat, and serve those living with substance abuse problems and provide them with services that have been based on the constant collaboration between all stakeholders involved.

# Appendices

## Appendix A: Available Health Measures: Opioid-Related Prescribing, Morbidity, and Mortality Indicators

| **Mortality Indicators**<br>**Data Source: TN Death Statistical File**<br>**Availability: Annually**<br>**Latest Available Data: 2016**<br>**Stratification: Age, Race, Sex**<br>**Geographic Level: TN, Region, County** |
|---|
| **Indicator** |
| 1. All Drug Overdose Deaths, number and crude rate per 100,000 TN residents |
| 2. Drug Overdose Deaths Involving Opioids, number and crude rate per 100,000 TN residents |
| 3. Drug Overdose Deaths Involving Natural, Semi-synthetic and Synthetic Opioids, number and crude rate per 100,000 TN residents |
| 4. Drug Overdose Deaths Involving Natural and Semi-synthetic Opioids and methadone, number and crude rate per 100,000 TN residents |
| 5. Drug Overdose Deaths Involving Natural and Semi-synthetic Opioids, number and crude rate per 100,000 TN residents |
| 6. Drug Overdose Deaths Involving Synthetic Opioids Other than Methadone, number and crude rate per 100,000 TN residents |
| 7. Drug Overdose Deaths Involving Methadone, number and crude rate per 100,000 TN residents |
| 8. Drug Overdose Deaths Involving Heroin, number and crude rate per 100,000 TN residents |
| 9. Overdose Deaths Involving Fentanyl, number and crude rate per 100,000 TN residents |
| 10. Overdose Deaths Involving Buprenorphine, number and crude rate per 100,000 TN residents |
| 11. Overdose Deaths Involving Polysubstance Use, number and crude rate per 100,000 TN residents |
| 12. Overdose Deaths Involving Cocaine, number and crude rate per 100,000 TN residents |
| 13. Overdose Deaths Involving Stimulants (Other than Cocaine), number and crude rate per 100,000 TN residents |
| 14. Overdose Deaths Involving Benzodiazepines, number and crude rate per 100,000 TN residents |
| 15. Overdose Deaths Involving Opioids and Benzodiazepines, number and crude rate per 100,000 TN residents |
| 16. Overdose Deaths Involving Opioids and Stimulants (Other than Cocaine), number and crude rate per 100,000 TN residents |
| 17. Overdose Deaths involving Opioids and Cocaine, number and crude rate per 100,000 TN residents |
| **Morbidity Indicators**<br>**Data Source: TN Hospital Discharge Data System**<br>**Availability: Quarterly**<br>**Latest Available Data: 2016**<br>**Stratification: Age, Race, Sex**<br>**Geographic Level: TN, Region, County** |
| **Indicator** |
| 1. Emergency Department Visits for All Drug Overdoses, number and crude rate per 100,000 TN residents |
| 2. Emergency Department Visits Involving All Opioid Overdoses Excluding Heroin, number and crude rate per 100,000 TN residents |
| 3. Emergency Department Visits Involving Heroin Overdose, number and crude rate per 100,000 TN residents |
| 4. Inpatient Hospitalizations for All Drug Overdoses, number and crude rate per 100,000 TN residents |
| 5. Inpatient Hospitalizations Involving All Opioid Overdoses, Excluding Heroin, number and crude rate per 100,000 TN residents |
| 6. Inpatient Hospitalizations Involving Heroin Overdose, number and crude rate per 100,000 TN residents |
| 7. Outpatient Visits for All Drug Overdoses, number and crude rate per 100,000 TN residents |
| 8. Outpatient Visits Involving All Opioid Overdoses Excluding Heroin, number and crude rate per 100,000 TN residents |
| 9. Outpatient Visits Involving Heroin Overdose, number and crude rate per 100,000 TN residents |

## Prescription Indicators

**Data Source: TN Controlled Substances Monitoring Database**
**Availability: Near real time**
**Latest Available Data: Q4 2017**
**Geographic Level: TN, Region, County**

| Indicator |
|---|
| 1. Opioid Prescriptions for Pain Filled Overall and by Drug, number and crude rate per 1,000 TN residents |
| 2. Buprenorphine Prescriptions for Medication Assisted Treatment, number and crude rate per 1,000 TN residents |
| 3. Benzodiazepine Prescriptions Filled Overall and by Drug, number and crude rate per 1,000 TN residents |
| 4. Percent of Patients Filling Prescriptions of Opioids for Pain of More than 90 or 120 Daily Morphine Milligram Equivalents (MME) |
| 5. Multiple Provider Episodes, number and rate per 100,000 residents |
| 6. Total MME for Opioids for Pain, number and crude rate per capita |
| 7. Percent of Patients Prescribed Long-Acting/Extended Release Opioids who Were Opioid-Naïve for at Least 60 Days |
| 8. Percent of Patient Prescription Days with Overlapping Opioid Prescriptions |
| 9. Percent of Patient Prescription Days with Overlapping Benzodiazepine Prescriptions |
| 10. Proportion of Patients with Concurrent Opioid and Benzodiazepine Prescriptions Overlapping at Least 2 Days |

# Appendix B: Health Enterprise Warehouse (HEW)/Integrated Data System (IDS)

The Health Enterprise Warehouse (HEW) was created to integrate data from the various divisions within the Tennessee Department of Health (TDH) and provide a definitive source which supports analysis and data visualization across the entire department. This system, which was built originally to support work on the Prescription Drug Overdose Epidemic, will also pivot to support addressing other, future epidemics. It currently includes data from the CSMD, the Hospital Discharge Data System, and Vital Statistics. Additional data sets being added include law enforcement data, hospital overdose reporting and medical examiner case management data. The HEW supports the work of epidemiologists and statisticians and the Office of General Counsel. The integrated data system has allowed TDH, for the first time, to link individual patients across data sets to understand the relationship of prescribing history (from the CSMD) to clinical outcomes (from HDDS and Vital Statistics). In addition, the integrated data system can be directly accessed to obtain data to conduct on demand data analyses and epidemiologic studies.

The HEW is a data warehouse specifically architected to support efficient and intuitive usability by reducing data elements to the minimum needs of each use case, linking disparate data sources via use of Entity Management techniques, standardizing definitions of common elements across data sources, and providing well defined data hierarchies where possible. It is designed utilizing a constellation schema which is a variation of star schema where multiple facts share common dimensions to reduce overhead and enable direct linking between facts. There are two additional databases (Staging and Operational Data Store) that perform the functions of extracting the data from the source, transforming the data into the proper format, maintaining standards across different sources, and enforcing data integrity for all data that is contained within the HEW. These three databases reside on a server which is dedicated only to the HEW in order to eliminate outside resource contention. Additionally, the full data from each source is permanently stored in a database called the Repository. This server also maintains the Entity Management process for all sources, to provide unique identifiers for de-duplicated entities (Person and Address). The Repository requires a very large amount of space to hold the entirety of the source data but is not heavily accessed and the Entity Management requires intensive processing but does not need a large amount of disk space. To eliminate resource contention, these are hosted on a separate server from the HEW; but they are hosted together because their different functionalities result in minimal resource contention with each other.

The HEW and its supporting databases are hosted across four virtual servers running Windows Server 2012 R2 and Microsoft SQL Server 2016, each with 8 processing cores and 128 GB of RAM. The servers are split into Production and Test and then into Data Management and Data Architecture; the Repository database and Entity Management process reside on the Data Management server and the Staging, Operational Data Store, and HEW databases are located on the Data Architecture server. Several additional services process the data for analytics and visualization. SQL Server Integrated Services is used to load data from the original sources into SQL Server. SQL Server Analysis Services will be used to create multidimensional cubes for analysis. Tableau is being used to provide visualization through interactive dashboards.

One of the main purposes of the HEW is to calculate new variables that serve as indicators in the opioid epidemic, and can be recalculated regularly and automatically. A number of these are grant

required and also serve to populate the TDH Prescription Drug Overdose dashboard. These indicators track drug overdose deaths, overdose-related inpatient and outpatient hospital visits, and a variety of opioid prescription trends (See **Appendix A** above for detailed list of indicators). Another purpose of the HEW is to automate the analysis of high risk patient and prescriber models that will run regularly as appropriate and flag high risk individuals and situations. The models for prescribers are under development for deployment in the first quarter of 2018. Additional models for dispensers also will be developed. The models for patients are being developed in collaboration with Vanderbilt University Medical Center, and we hope to have them deploying in the second quarter of 2018.

# Appendix C: Technical Notes

## Technical Notes: Tennessee Opioid Prescription Indicators

| Indicators | Opioid and Benzodiazepine Prescription Trends among Tennessee Residents |
|---|---|
| **Measures** | 1. Number of Opioid and Benzodiazepine Prescriptions in TN by Quarter, page 10<br>2. Prescription Rate (crude)[52] per 1,000 residents of Top 3 Most Prescribed Short-Acting Opioids for Pain in TN by quarter, page 11<br>3. Prescription Rate (crude) per 1,000 Residents of Top 4 Most Prescribed Benzodiazepines in TN by Quarter, page 12<br>4. [Map] Opioids for Pain Prescription Rate (crude) per 1,000 Residents by TN County of Residence: 2013 & 2017, page 13<br>5. [Map] Buprenorphine for MAT Prescription Rate (crude) per 1,000 Residents by TN County of Residence: 2013 & 2017, page 14<br>6. [Map] Benzodiazepine Prescription Rate (crude) per 1,000 Residents by TN County of Residence: 2013 & 2017, page 15<br>7. Opioid Prescriptions for Pain by Payment Type in TN by Year, page 16<br>8. Benzodiazepine Prescriptions for Pain by Payment Type in TN by Year, page 16<br>9. Patients Receiving Opioid and Benzodiazepine Prescriptions in TN by Quarter, page 17<br>10. Patients Receiving Buprenorphine for Medication-Assisted Treatment in TN by Quarter, page 17<br>11. [Table] Active Opioid Prescription Days by Year for Patients in TN, page 18<br>12. [Table] Active Prescription Days for Patients Prescribed Opioids for Pain in TN, page 18<br>13. Number of Patients Receiving Top 3 Prescribed Short-Acting Opioids for Pain in TN by Quarter, page 19<br>14. Top 3 Prescribed Short-Acting Opioids for Pain Prescriptions per Patient in TN by Quarter, page 20<br>15. Number of Patients Prescribed Most Common Benzodiazepines in TN by Quarter, page 21<br>16. Number of Most Common Benzodiazepine Prescriptions per Patient in TN by Quarter, page 22<br>17. Percent of Patients Dispensed More Than 90 Daily MME in TN by Quarter, page 23<br>18. Percent of Prescribers of Opioids for Pain Averaging >90 MME in TN by Quarter, page 23<br>19. Percent of Patients with Overlapping Opioid and Benzodiazepine Prescriptions in TN by Quarter, page 24<br>20. Rate (crude) of Multiple Provider Episodes (per 100,000) Residents in TN by Half Year, page 24 |
| **Definition of Measures** | Number of opioid and benzodiazepine prescriptions in TN<br>• After exclusions, a count of all prescriptions filled in each category as identified by the CDC's MME Conversion Table<br><br>Rate (crude) per 1,000 residents for opioid and benzodiazepine prescriptions in TN<br>• *Numerator*: Number of prescriptions filled<br>• *Denominator*: Yearly state population in 1,000s<br><br>Prescription rate (crude) per 1,000 residents of top 3 most prescribed short-acting opioids for pain in TN by quarter<br>• *Numerator*: Number of prescriptions filled for top 3 most filled types of short-acting |

[52] Rates without indication of "age-adjusted" are assumed to be crude rates in main body of report.

opioid analgesics
- *Denominator*: Yearly state population in 1,000s

Prescription rate (crude) per 1,000 residents of top 4 most prescribed benzodiazepines in TN by quarter
- *Numerator*: Number of prescriptions filled for top 4 most filled types of benzodiazepines
- *Denominator*: Yearly state population in 1,000s

Opioid for pain/buprenorphine for MAT/benzodiazepine prescription rate (crude) per 1,000 residents by TN county of residence
- *Numerator*: Number of prescriptions filled
- *Denominator*: Yearly county population in 1,000s

Number of patients receiving opioid and benzodiazepine prescriptions in TN
- Count of unique patients who filled at least one prescription for opioid analgesics, opioids for treatment, or benzodiazepines

Prescriptions for opioids and benzodiazepine per patient in TN
- *Numerator*: Count of all prescriptions filled for opioid analgesics, opioids for treatment, or benzodiazepines
- *Denominator*: Count of unique patients who filled at least one prescription for opioid analgesics, opioids for treatment, or benzodiazepines
- Note: Only patients who have ever received at least one prescription in the relevant categories for the year are considered in each denominator

Active opioid prescription days by year for patients in the CSMD
- For each patient in the CSMD, a count of the days in each year with an active prescription (based on the date filled and the days supply), described as the mean and median for all patients

Number of patients receiving top 3 prescribed short-acting opioids for pain in TN
- Count of unique patients who filled at least one prescription for the top 3 most filled short-acting opioid analgesics

Prescriptions per patient for top 3 prescribed short-acting opioids for pain in TN
- *Numerator*: Number of prescriptions filled as defined above for top 3 most filled types of short-acting opioid analgesics
- *Denominator*: Count of unique patients who filled at least one prescription for the top 3 most filled short-acting opioid analgesics
- Note: Only patients who have ever received at least one prescription of the relevant opioid for the year are considered in each denominator

Number of patients receiving top 4 prescribed benzodiazepines in TN
- Count of unique patients who filled at least one prescription for the top 4 most filled types of benzodiazepines

Prescriptions per patient for top 4 prescribed benzodiazepines in TN
- *Numerator*: Number of prescriptions filled as defined above for top 4 most filled types of benzodiazepines

| | |
|---|---|
| | • *Denominator*: Count of unique patients who filled at least one prescription for the top 4 most filled types of benzodiazepines<br>• Note: Only patients who have ever received at least one prescription of the relevant benzodiazepine for the year are considered in each denominator<br><br>Percent of patients dispensed more than 90 daily morphine milligram equivalents in TN<br>• *Numerator*: Number of unique patients with filled prescriptions for opioid analgesics of more than 90 or 120 daily MME for all days prescribed in a quarter (may include single >90 or >120 prescriptions or multiple overlapping prescriptions)<br>• *Denominator*: Number of unique patients with filled prescriptions for any opioid analgesics<br><br>Percent of patients with overlapping opioid and benzodiazepine prescriptions<br>• *Numerator*: Number of unique patients who have an benzodiazepine prescription that overlaps an opioid prescription<br>• *Denominator*: Number of unique patients with filled prescriptions for any opioid analgesics<br>• Note: Prescription dates are based on date of prescription fill and days supply<br><br>Rate (crude) of multiple provider episodes per 100,000 residents in TN<br>• *Numerator*: Number of unique patients who filled prescriptions from 5 distinct prescribers and at 5 distinct dispensers within one half of the year (Jan 1 – June 30 or July 1 – Dec 31)<br>• *Denominator*: Yearly state population in 100,000s<br><br>Percent of prescribers of opioids for pain averaging >90 MME in TN<br>• *Numerator*: Number of prescribers whose opioid for pain prescriptions in each quarter averaged more than 90 morphine milligram equivalents<br>• *Denominator*: Number of prescribers who prescribed opioids for pain in each quarter |
| **Geographic Scale** | Tennessee — Statewide and County |
| **Time Period** | 2013 –2017 |
| **Inclusion/Exclusion Criteria** | • Only Tennessee residents were considered<br>• Only drug schedules II, III, and IV were included<br>• Only drugs identified in the CDC's 2017 MME Conversion Table were considered<br>  ▪ Type of opioid or benzodiazepine and short or long acting nature of opioids identified by the CDC's 2017 MME Conversion Table<br>  ▪ Opioid prescriptions were separated into two categories: opioids FDA label indicated for pain (analgesics) and opioids FDA label indicated for medication assisted treatment (MAT)<br>• Prescriptions with zero or implausibly high quantities were excluded<br>• Prescriptions with zero or implausibly high days supply were excluded |
| **Data Sources** | • Tennessee Controlled Substance Monitoring Database (CSMD)<br>• CDC's 2017 MME Conversion Table<br>• Population data for 2013-2016 was obtained from CDC Wonder bridged race populations estimates. The vintage year of the populations corresponds to the year of the indicator. (See http://wonder.cdc.gov/bridged-race-population.html for more details). Estimated rates for 2017 use the 2016 population because 2017 estimates were not available at the time of publication. |

| | |
|---|---|
| **General Limitations of the Measures** | • Prescriptions that were written but not filled by the patient are not tracked in the CSMD. The CSMD provides a reasonably accurate measure of the amount of controlled substances dispensed in TN, but may not capture the full extent of prescribing practices.<br>• The CSMD does not have information on patient behavior beyond filling prescriptions. Measures are calculated with the assumption patients take their medications as prescribed. Patients may choose not to take their medication or may share medications with others.<br>• The CSMD does not include information about diagnoses or the indicated use for each prescription. Measures are calculated with the assumption medications are prescribed for their FDA-label indicated uses (e.g., pain treatment or medication assisted substance abuse treatment). Off-label use cannot be determined.<br>• Opioid prescriptions were identified in the CSMD through the use of the CDC's MME Conversion Table which may not capture all opioid or benzodiazepine prescriptions. The CDC MME table includes most but not all controlled substances prescribed in TN. Notable exceptions were methadone used for treatment which was not monitored by the CSMD and opioid drugs used in inpatient settings.<br>• The CSMD's patient records contain numerous duplicate patients that must be consolidated using a unique patient identifier across records identified as belonging to a single person. Analyses for this report used a simple deterministic approach to identify unique patients that involved matching first name, last name, and date of birth. This simple data linkage approach results in a small overestimate of the number unique patients, and we are continually improving patient identification techniques to improve indicator calculation.<br>• TN residence and county of residence were determined by patient address listed in the CSMD's patient records. Patient addresses may not be accurate when pharmacy patient records are not updated or if patients give inaccurate information. If valid street address information was unavailable, counties were assigned according to city and zip code. TN patients whose county could not be identified were given assigned county "Unknown". |

# Technical Notes: Drug Overdose Death Indicators

| Indicators | Drug Overdose Deaths in Tennessee, 2012-2016 |
|---|---|
| **Measures** | 1. Age-Adjusted Rates for All Drug Overdose Deaths by Sex and Race in TN by Year, page 26<br>2. [Map] Percent Change in Number of All Drug Overdose Deaths by TN County of Residence, 2012-2016, page 27<br>3. Opioids Present in Overdose Deaths in TN by Year, page 28<br>4. Age-Adjusted Rates for Opioid Overdose Deaths in TN by Year, page 29<br>5. [Table] Number of People who Died of a Drug Overdose in TN by Contributing Substance, 2013-2016, page 30<br>6. Age-specific Rates of Opioid Overdose Deaths in TN by Year, page 31<br>7. Age-specific Rates of Natural and Semi-Synthetic Opioid Overdose Deaths in TN by Year, page 31<br>8. Age-specific Rates of Heroin Overdose Deaths for Selected Age Group in TN by Year, page 32<br>9. All Opioid Overdose Deaths by Race and Sex in TN by Year, page 33<br>10. Natural and Semi-Synthetic Opioid Overdose Deaths by Race and Sex in TN by Year, page 33<br>11. Heroin Overdose Deaths by Race and Sex in TN by Year, page 34<br>12. Fentanyl Overdose Deaths by Race and Sex in TN by Year, page 34<br>13. [Map] Percent Change in Number of Opioid Drug Overdose Deaths by TN County of Residence, 2012-2016, page 35<br>14. [Map] Number of Fentanyl and Heroin Overdose Deaths by TN County of Residence, 2016, page 36<br>15. Contributing Opioids among All Opioid/Natural and Semi-Synthetic Opioid/Heroin/Fentanyl Overdose Deaths in TN by Year, page 37<br>16. [Table] Death Certificate Quality Indicators for Cause of Death Information, 2012-2016, page 39<br>17. Polydrug Overdose Deaths in TN by Year, page 40 |
| **Definition of measures** | Overdose deaths are determined by International Classification of Disease, 10th Revision (ICD10) codes listed as the underlying cause of death in the Death Statistical File. These codes are created by the National Center for Health Statistics from the cause of death text fields on death certificates. Contributing substances are generally determined by ICD10 codes in the multiple cause of death fields in the statistical file. Some causes of death cannot be determined by these codes and instead are derived from the cause of death text entered on the death certificate. Relevant ICD10 codes or literal text searches are listed below.<br><br>All Drug Overdose – underlying cause of death code falls in one of the following ranges:<br>• X40-X44 (Accidental poisoning by drugs)<br>• X60-X64 (Intentional self-poisoning by drugs)<br>• X85 (Assault by drug poisoning)<br>• Y10-Y14 (Drug poisoning of undetermined intent)<br><br>All Opioid Overdose – Meets all drug overdose criteria *and* contains at least one of the following codes as a contributing cause of death:<br>• T40.0 (Acute poisoning by opium)<br>• T40.1 (Acute poisoning by heroin)<br>• T40.2 (Acute poisoning by natural or semi-synthetic opioids) |

- T40.3 (Acute poisoning by methadone)
- T40.4 (Acute poisoning by synthetic opioids other than methadone)
- T40.6 (Acute poisoning by other or unspecified narcotics)

Natural, Semi-Synthetic, and Synthetic Opioid Overdose – Meets all drug overdose criteria *and* contains at least one of the following codes as a contributing cause of death

- T40.2 (Acute poisoning by natural or semi-synthetic opioids)
- T40.3 (Acute poisoning by methadone)
- T40.4 (Acute poisoning by synthetic opioids other than methadone)

Natural, Semi-Synthetic, or Methadone – Meets all drug overdose criteria *and* contains at least one of the following codes as a contributing cause of death:

- T40.2 (Acute poisoning by natural or semi-synthetic opioids)
- T40.3 (Acute poisoning by methadone)

Natural and Semi-Synthetic – Meets all drug overdose criteria *and* contains the following code as a contributing cause of death:

- T40.2 (Acute poisoning by natural or semi-synthetic opioids)

Synthetic (other than methadone) – Meets all drug overdose criteria *and* contains the following code as a contributing cause of death:

- T40.4 (Acute poisoning by synthetic opioids other than methadone)

Methadone – Meets all drug overdose criteria *and* contains the following code as a contributing cause of death:

- T40.3 (Acute poisoning by methadone)

Heroin – Meets all drug overdose criteria *and* contains the following code as a contributing cause of death:

- T40.1 (Acute poisoning by heroin)

Fentanyl – Meets all drug overdose criteria *and* contains text 'FENTAN' in written cause of death on certificate

Buprenorphine – Meets all drug overdose criteria *and* contains text 'BUPRE' OR 'NORPH' in written cause of death on certificate

Opioids and Benzodiazepines: Meets all opioid overdose criteria *and* contains the following code as a contributing cause of death

- T42.4 (Acute poisoning by benzodiazepines)

Age/Race/Sex stratification

- Age is determined according to date of birth and date of death.
- Race and sex are reported on the death certificate.
- Due to low numbers, decedents of unknown race, Native American, Alaskan Native, Asian or Pacific Islander or listed as unknown are not included in figures.

The denominator for all rates is the state or county population in 100,000s. Age-adjustment is used for all fatal overdose rates except for those stratified by age. Age-adjusted rates were calculated using 2000 US standard population for age-adjustment. The rate for a specific age

| | |
|---|---|
| | group in a given population was multiplied by the proportion of people in the same age group in the 2000 U.S. standard population; adding across age groups yields the final age-adjusted rate.<br><br>Percent change is calculated using the following formula: ((most recent number - earliest number)/earliest number) X 100**.** Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 overdose deaths to 197 is an absolute change of 67 overdose deaths, but only a percent change of 51.5%. |
| **Geographic Scale** | Tennessee — Statewide, County |
| **Time Period** | 2012 – 2016 |
| **Inclusion/Exclusion Criteria** | • Only Tennessee residents were considered<br>• Tennessee residents who died of an overdose out of state are included<br>• Includes only deaths determined to have been caused by acute poisonings |
| **Data Sources** | • Tennessee Death Statistical File, 2012-2016<br>• Population data for 2013-2016 was obtained from CDC Wonder bridged race populations estimates. The vintage year of the populations corresponds to the year of the indicator. (See http://wonder.cdc.gov/bridged-race-population.html for more details). |
| **General Limitations of the Measures** | • Any indicator that relies on literal text for calculation is limited in cases where drug types are not reported on the certificate. In particular, death records of TN residents that occur out-of-state do not include cause of death text; literal text indicators cannot be determined for these deaths.<br>• Determination of overdose deaths often requires autopsies and toxicology testing that is dependent on a county's resources and ability to conduct such investigations. Although a drug death may be suspected, it may not be entered as such on the death certificate and therefore cannot be coded with certainty by NCHS. Drug deaths that are coded with ICD10 code R99 (other ill-defined and unspecified causes of mortality) do not contribute to the counts. Fortunately, the quality of reporting overdoses on death certificates in TN has improved over time. See the death certificate epidemiology methods section above in for further information. |

# Technical Notes: Non-Fatal Drug Overdose Indicators

| Indicators | Drug Overdose Outpatient Visits and Inpatient Stays Rates by County among Tennessee Residents |
|---|---|
| **Measures** | 1. Age-adjusted Rates for All Drug Overdose Outpatient Visits and Inpatient Stays in TN by Year, page 41<br>**2.** [Map] Percent Change in Number of All Drug Overdose Outpatient Visits by TN county of residence: 2012 & 2015, page 42<br>**3.** [Map] Percent Change in Number of All Drug Overdose Inpatient Visits by TN county of residence: 2012 & 2015, page 43<br>4. Age-Adjusted rates for opioid overdose outpatient visits and inpatient stays in TN by year, page 44<br>5. Age-adjusted Rates for Outpatient Visits and Inpatient Stays for Opioid Overdoses excluding Heroin by Sex in TN by Year, page 45<br>6. Age-adjusted Rates for Heroin Overdose Outpatient Visits and Inpatient Stays by Race in TN by Year, page 45<br>7. Age-specific Rates for Outpatient Visits and Inpatient Stays for Opioid Overdoses excluding Heroin by Age in TN by Year, page 46<br>8. Age-adjusted Rates for Hospital Discharges and Deaths due to Opioids Excluding Heroin in TN by Year, page 47<br>9. Age-adjusted Rates for Hospital Discharges and Deaths due to Heroin in TN by Year, page 48<br>10. [Map] Age-adjusted Rates for Opioid excluding Heroin Overdose Outpatient Visits by TN region of residence: 2012 & 2015, page 49<br>11. [Map] Age-adjusted Rates for Opioid excluding Heroin Overdose Inpatient Visits by TN region of residence: 2012 & 2015, page 50<br>12. [Map] number of Heroin Overdose Outpatient Visits and Inpatient Stays by TN Region of residence: 2012 & 2015, page 51 |
| **Definition of Measures** | Inpatient stays and outpatient visits determined by flag in Hospital Discharge Data System (HDDS). Generally, inpatient stays are hospitalizations lasting longer than 24 hours while outpatient visits are those less than 24 hours.<br><br>Overdose is determined by International Classification of Disease (ICD), Clinical Modification, 9th or 10th revision codes available in the HDDS discharge records. Prior to October 1, 2015, hospitals reported 9th revision codes (ICD-9-CM) and afterward reported 10th revision codes (ICD-10-CM). Relevant codes for each revision are listed for each rate definition below.<br><br>Age-adjusted rates for all drug overdose outpatient visits and inpatient stays<br>• *Numerator* – count of outpatient visits or inpatient stays caused by acute poisonings due to the effects of drugs, regardless of intent<br>o ICD-9-CM principal diagnosis codes:<br>960-979 (poisoning by drugs, medicinal, and biological substances)<br>OR first-listed external cause of injury codes:<br>E850-E858 (accidental poisoning by drugs, medicinal, and biological substances),<br>E950.0-E950.5 (self-inflicted poisoning by solid or liquid substances),<br>E962.0 (assault by drugs and medicinal substances),<br>or E980.0-E980.5 (poisoning by solid or liquid substances of undetermined |

intent)
    - ICD-10-CM principal diagnosis codes:
      T36-50 (poisoning by drugs, medicaments, and biological substances) with intent codes 1-4 (accidental, intentional, assault, or undetermined) and encounter code A, D, or missing (initial or subsequent encounter but not a sequela)
- *Denominator* – Yearly state/region/county population in 100,000s

Age-adjusted rates for opioid overdose excluding heroin outpatient visits and inpatient stays in TN by year

- *Numerator* - count of outpatient visits or inpatient stays caused by acute poisonings due to the effects of all opioids excluding heroin, regardless of intent
    - ICD-9-CM principal diagnosis codes:
      965.00 (poisoning by opium),
      965.02 (poisoning by methadone),
      or 965.09 (poisoning by other opiates and related narcotics)
      OR first-listed external cause of injury codes:
      E850.1 (accidental poisoning by methadone)
      or E850.2 (accidental poisoning by other opiates and related narcotics
    - ICD-10-CM principal diagnosis codes:
      T40.0X (poisoning by opium),
      T40.2X (poisoning by other opioids),
      T40.3X (poisoning by methadone),
      T40.4X (poisoning by synthetic narcotics),
      T40.60 (poisoning by unspecified narcotics),
      or T40.69 (poisoning by other narcotics)
      with intent codes 1-4 (accidental, intentional, assault, or undetermined) and encounter code A, D, or missing (initial or subsequent encounter but not a sequela)
- *Denominator* – Yearly state/region/county population in 100,000s

Age-adjusted rates for heroin overdose outpatient visits and inpatient stays in TN by year

- *Numerator* - count of outpatient visits or inpatient stays caused by acute poisonings due to the effects of heroin, regardless of intent
    - ICD-9-CM principal diagnosis code:
      965.01 (poisoning by heroin)
      OR first-listed external cause of injury code:
      E850.0 (accidental poisoning by heroin)
    - ICD-10-CM principal diagnosis codes:
      T40.1X (poisoning by heroin)
      with intent codes 1-4 (accidental, intentional, assault, or undetermined) and encounter code A, D, or missing (initial or subsequent encounter but not a sequela)
- *Denominator* – Yearly state/region/county population in 100,000s

Age/Race/Sex stratification

- Age is determined according to date of birth and at date of admission to hospital.
- Race and sex are reported by the hospital to the hospital discharge data system.
- Due to low numbers, patients of unknown race, Native American, Alaskan Native,

| | |
|---|---|
| | Asian or Pacific Islander or listed as unknown are not included in figures<br><br>Age-adjustment is used for all non-fatal overdose rates except for those stratified by age. Age-adjusted rates were calculated using 2000 US standard population for age-adjustment. The rate for a specific age group in a given population was multiplied by the proportion of people in the same age group in the 2000 U.S. standard population; adding across age groups yields the final age-adjusted rate.<br><br>Percent change is calculated using the following formula: ((most recent number - earliest number)/earliest number) X 100. Percent change values should be interpreted with the caveat that the absolute change may be small, but the percent change value may be large. For example, a change from 1 death to 2 deaths is an absolute change of 1 overdose death, but a percent change of 100%. Alternatively, a change from 130 overdose deaths to 197 is an absolute change of 67 overdose deaths, but only a percent change of 51.5%. |
| **Geographic Scale** | Tennessee — Statewide, TDH regions, County |
| **Time Period** | 2012 – 2016 |
| **Inclusion/Exclusion Criteria** | • Only Tennessee residents were considered<br>• Only discharges from non-federal, acute care hospitals were included<br>• Excludes patients discharged as dead/deceased<br>• Late effects, adverse effects, and chronic poisonings due to the effects of drugs were excluded<br>• County/region determined by patient's county/region of residence at hospitalization |
| **Data Sources** | • Tennessee Hospital Discharge Data System (HDDS) 2012-2016<br>• Population data for 2013-2016 was obtained from CDC Wonder bridged race populations estimates. The vintage year of the populations corresponds to the year of the indicator. (See http://wonder.cdc.gov/bridged-race-population.html for more details). |
| **General Limitations of the Measures** | • Non-fatal overdoses are only captured as hospital discharges and do not include those non-fatal overdoses that do not end up at an acute-care facility.<br>• Cases are selected primarily on the basis of principal diagnosis codes, so some overdoses may not be captured if they were coded as a secondary diagnosis.<br>• Limited to non-federal acute care-affiliated facilities. Excludes VA and other federal hospitals, rehabilitation centers, and psychiatric hospitals |

# Data QA/Validation Process for TDH Prescription Drug Overdose Team

## Part A. Data Documentation

**Initial variable(column) names with:**

- All possible values/coding (as appropriate)
- Type (numeric, character, date format)
- Description of what the variable (column) provides information on (e.g., ICD-10 underlying cause of death codes)
- Documentation of visual inspection of variables to consider missing, implausible, and undocumented values
- Data source with location or how to access

**Data Selection Criteria/Exclusions**:

- Provide any selection criteria applied to the data to subset it (e.g., dates, geographic locations, ages, excluded missing) including:
  - numbers of observations excluded by criteria
  - Initial and final number of observations

**Created variables (columns) in the analytic process (e.g., transformations (recodes)):**

- Variable name
- All possible values/coding (as appropriate)
- Type (numeric, character, date format)
- Data source (table/database/dataset name(s) and how to access or where located)

**Variable distribution table for all variables (columns) used both initial and created, as appropriate**.

**Visual inspection of each variable (column) prior to use in analytics is critical to plan how the variables will be used/transformed (recoded) and for carefully implemented data cleaning strategies.**

## Part B. Annotated Program/Syntax

Include:

- At the top of the program:
  - Name of program
  - Author(s)
  - Date last modified
  - Purpose
  - Tables/datasets/databases used
  - Names of any data documentation or output files associated with the program and location of files (as appropriate).
- For each set of codes/syntax, provide a description of what the code is doing to enable interpretation by others.
- Make sure each variable (column) used is documented as shown in Part A.

## Part C. Data or Output to be Replicated

Provide the product to be checked.

Depending on the project, this could include (this is not an exhaustive list):

- Results in an excel spreadsheet
- Excel data file
- Results Tables/Figures in a Microsoft word document
- SAS dataset with data transformations (recodes) to be checked

**Overall Goal**: Implement best data practices in public health data science to support error free reporting of data and results for all products and communications (data briefs, dashboards, presentations, reports, abstracts, publications).

**Specific Objectives**: 1) enable all analytic Prescription Drug Overdose team members to provide data/outputs as needed for CDC grant reporting/TDH purposes and enable independent replication of these data/outputs; and 2) enable checking of data creation and transformations that are a major basis for primary PDO team study population selection, data linkage, and analyses; and 3) enable results checking for presentations, abstracts, and publications.

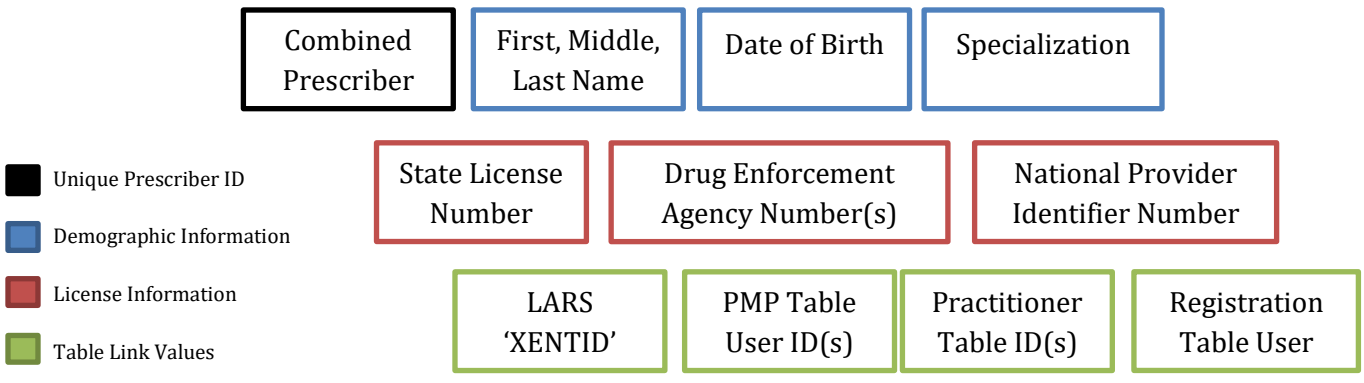
# Appendix D: Provider Entity Management

The OIA has undertaken an effort to improve the process by which prescriptions are linked to prescribers. After finding non-unique identifiers using only CSMD prescriber data, we developed an approach using additional data sources (Drug Enforcement Agency license data, and National Provider Identifier data from the Centers for Medicare and Medicaid Services) to create unique prescriber profiles. These additional data sources provided enough new data points to allow for unique prescriber 'cluster IDs' to be created, where all information about an individual across any data source could be aggregated into a single profile that can be compared against prescription data.

Initially, we found that using CSMD data only, the most effective prescriber-prescription linkage was a data element called the "PractitionerID." However, using our combined prescriber model we can match prescriptions to prescribers on PractitionerID, name, Drug Enforcement Agency Number(s) (some providers have multiple Drug Enforcement Agency Numbers, such as when they are licensed to dispense Suboxone), National Provider Identifier Number (when available in the prescription data), and state license number (when available in the prescription data).

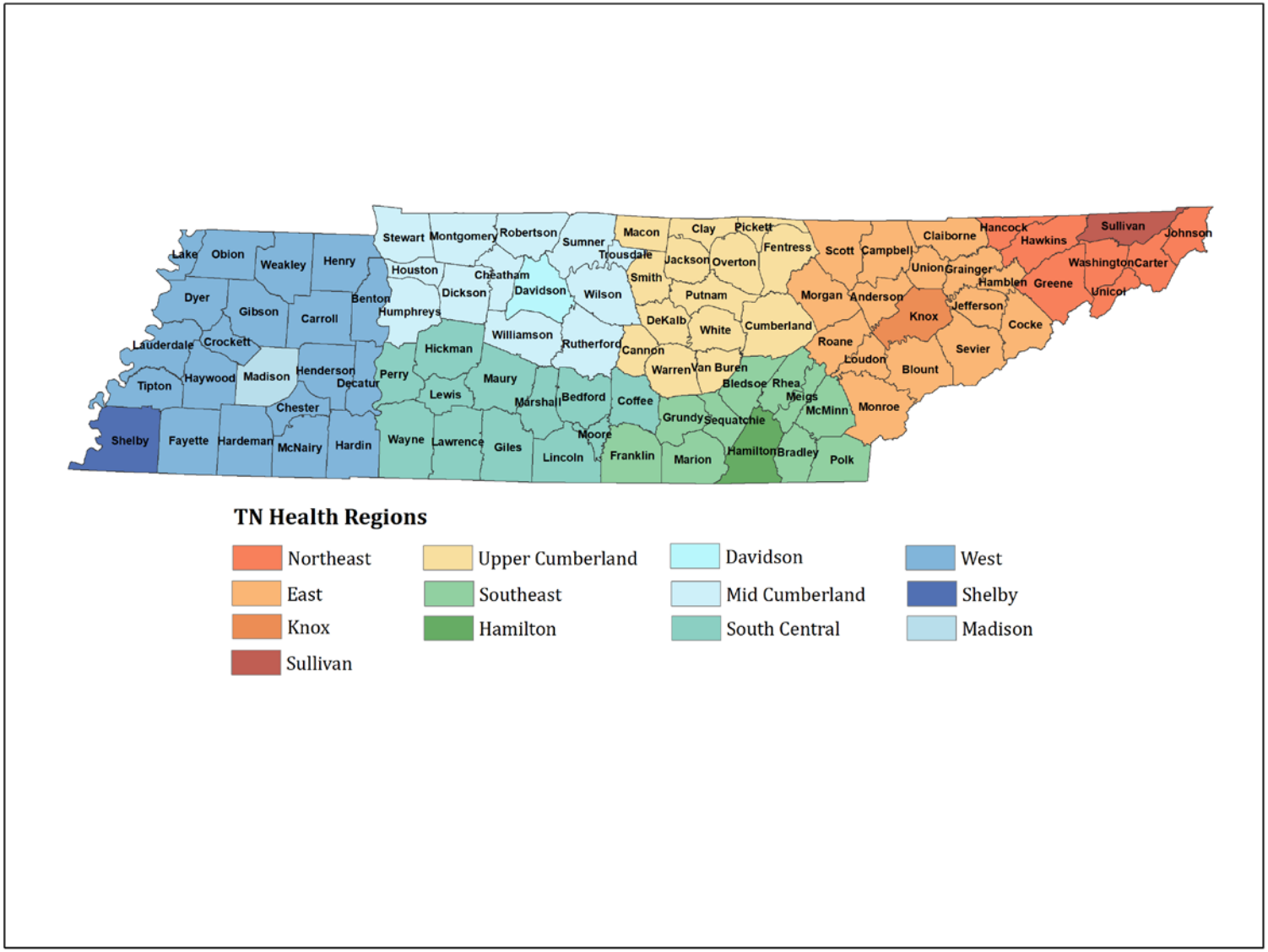
The combined prescriber ID basic schema is outlined in the figure below. There are four main elements, the unique ID (cluster ID), the demographic information, the license information, and the table link values. Demographic and License information are used mainly to link to prescription data, and the combined ID is used to aggregate the prescription data (for instance, if prescriptions are found by DEA Number and NPI Number separately for the same person, these are aggregated under the combined prescriber ID). The table link values allow us to link back to original data sources to pull other data elements that might be useful for further analysis, but are not used for primary prescription linkage. For instance, if we needed to get a practice address, we could use a table link value to refer to the source tables to get that information quickly.

**Main Components of the Clustered Prescriber ID**

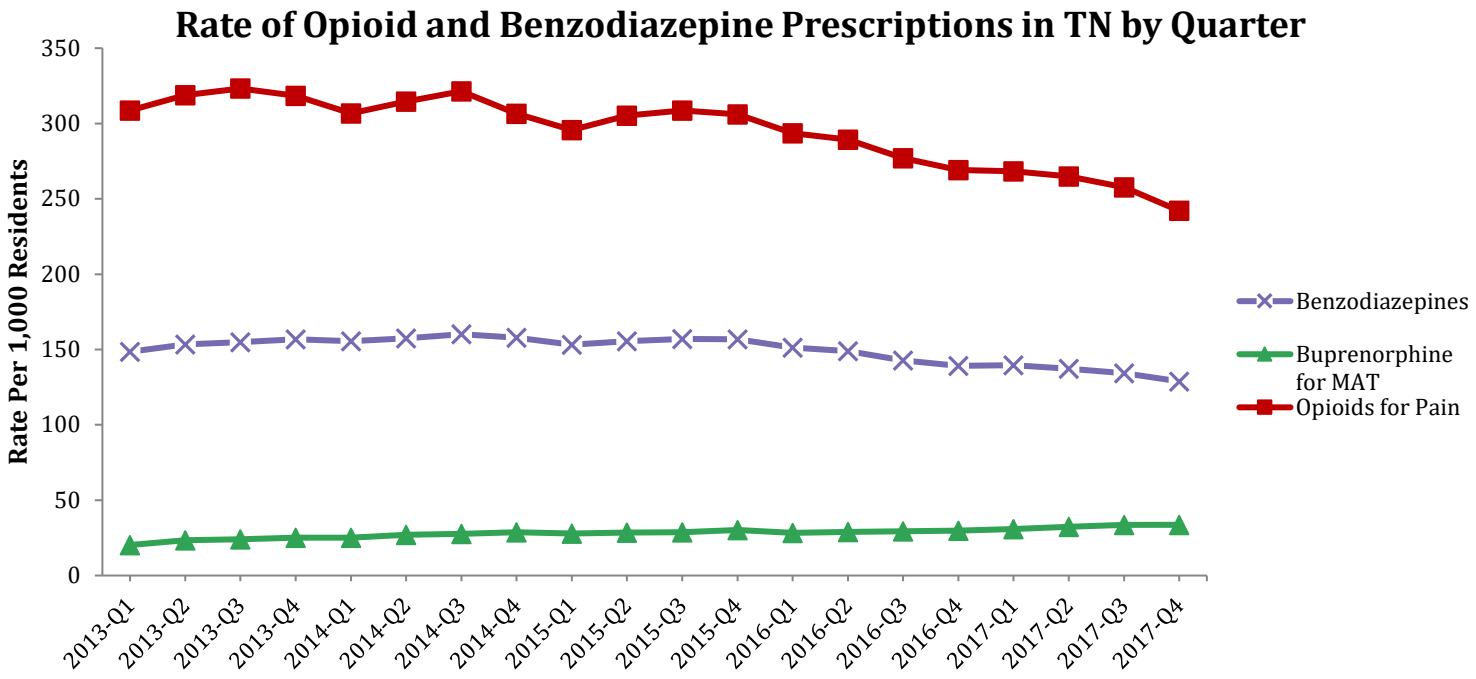


# Appendix E: Additional Figures and Data

E1. Map of TN Counties and Health Regions

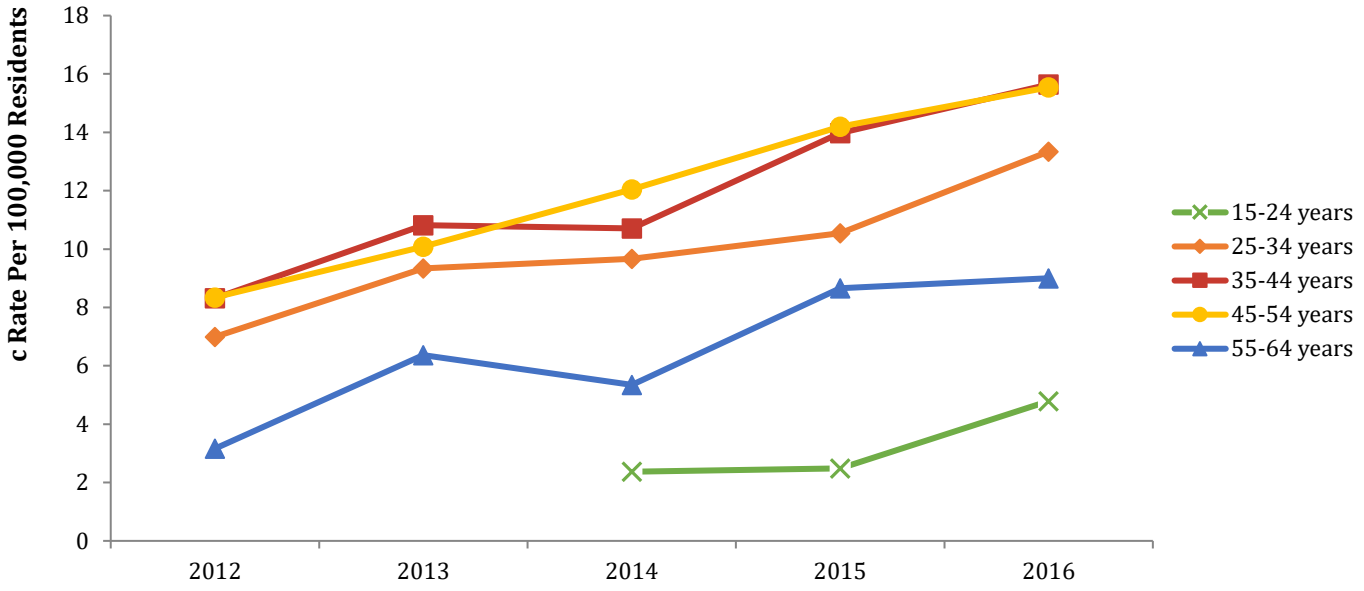


E2. Prescription Rate for Opioids and Benzodiazepines in TN by Quarter



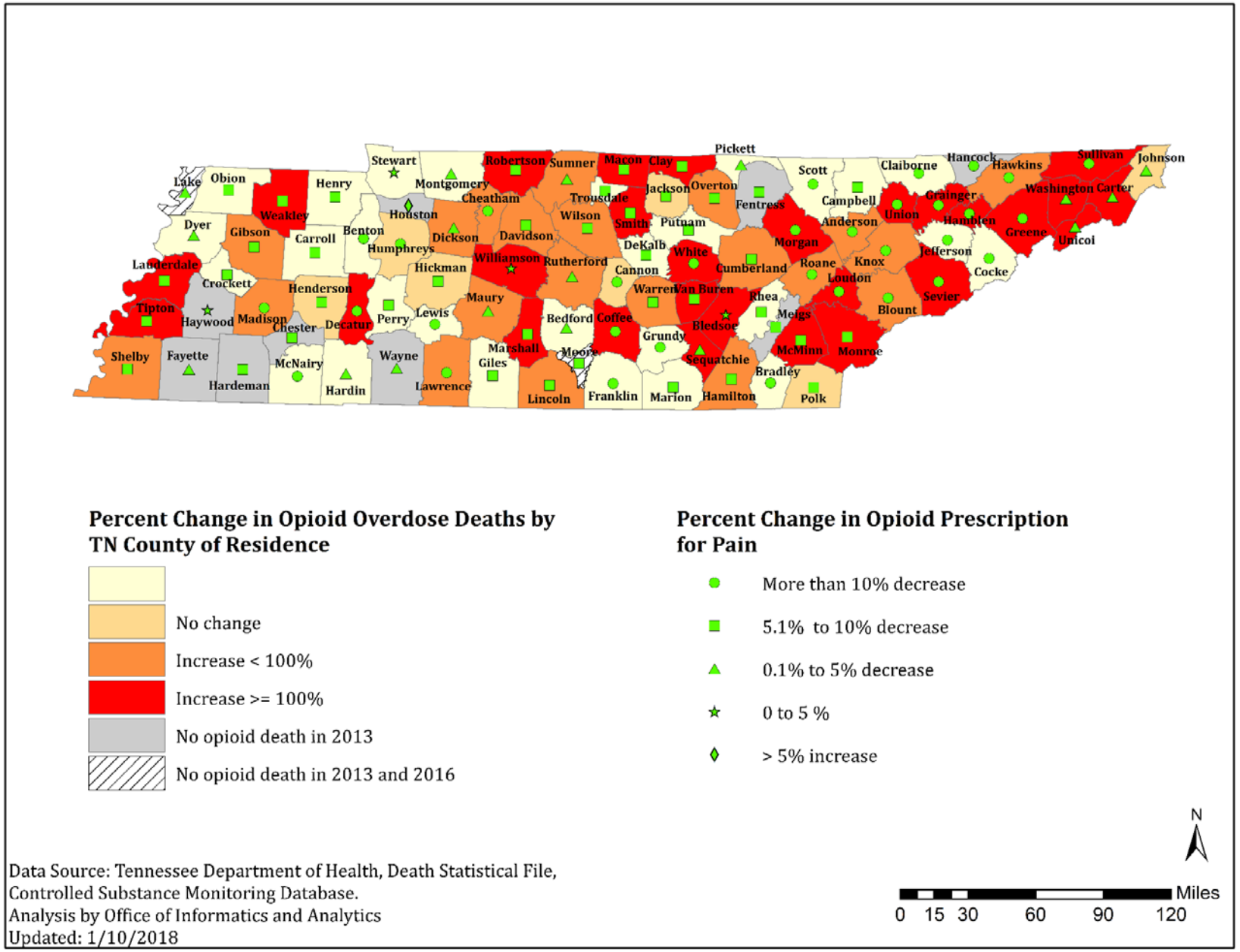

Analysis by Office of Informatics and Analytics, TDH (January 10, 2018). Limited to TN residents. Data Source: Controlled Substance Monitoring Database.

E3. Age-Specific Rates of Opioid and Benzodiazepine Overdose Deaths in TN by Year



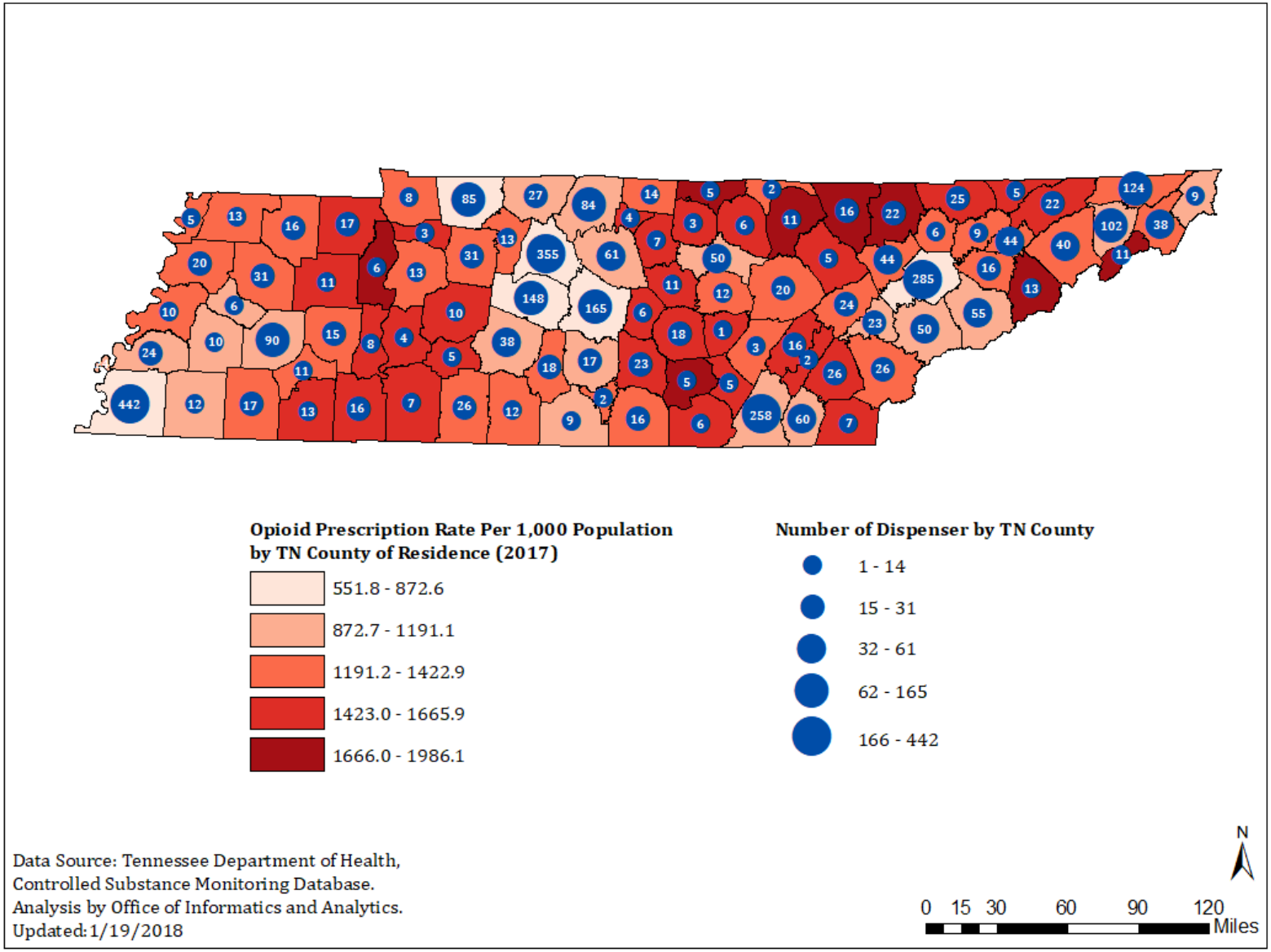

Analysis by the Office of Informatics and Analytics, TDH (last updated, December 15, 2017). Limited to TN residents. Rates for counts <20 were considered unreliable and not calculated (i.e., fentanyl in 2012). Data Source: TN Death Statistical File.

E4. Percent Change in Opioid Overdose Death and Opioid Prescription Rates in TN by County, 2013 to 2016

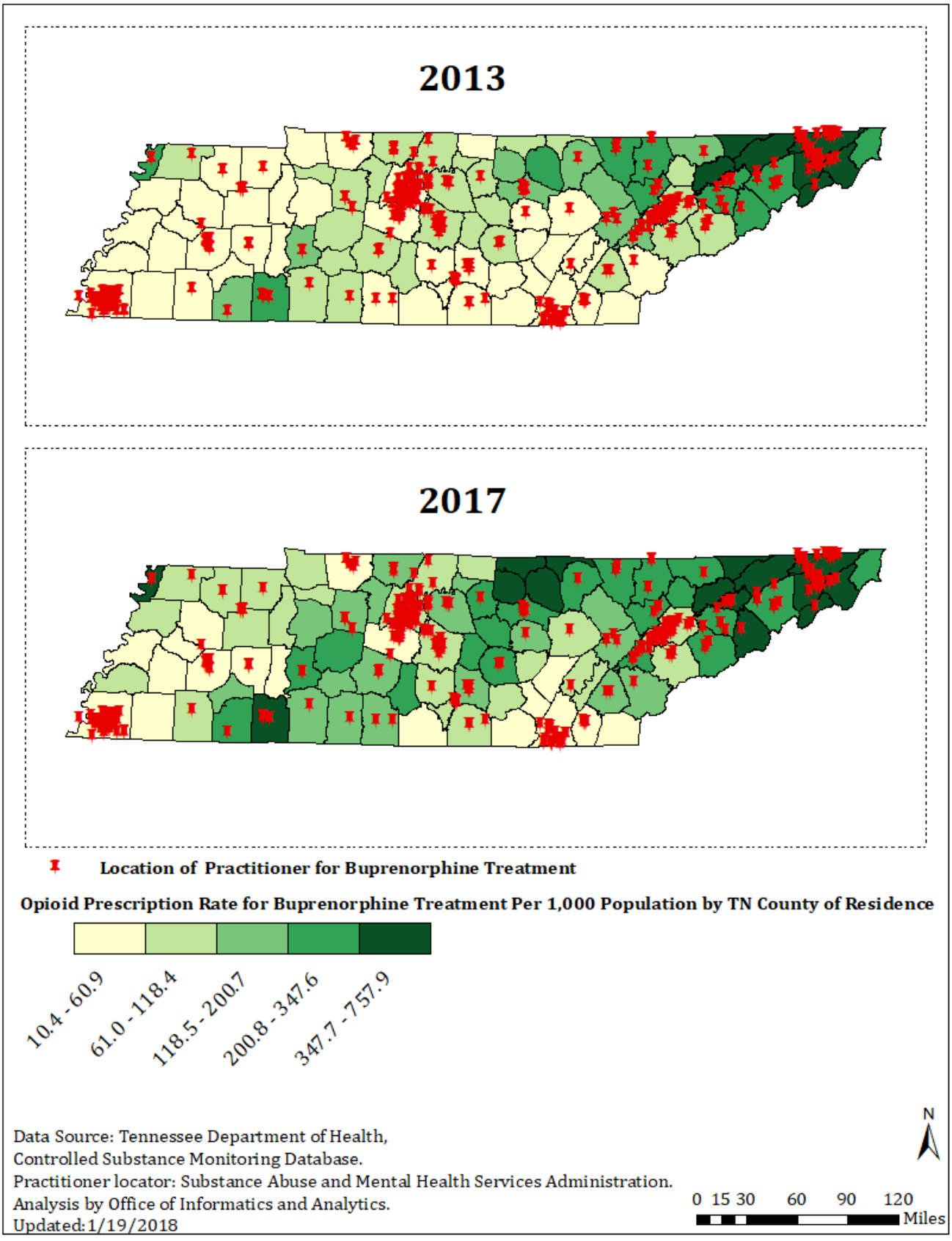



Data Source: Tennessee Department of Health, Death Statistical File,
Controlled Substance Monitoring Database.
Analysis by Office of Informatics and Analytics
Updated: 1/10/2018

E5. Opioid Prescription Rates and Number of Dispensers in TN by County, 2017



E6. Prescription Rates for Buprenorphine for Medication-Assisted Treatment and Buprenorphine Providers in TN by County: 2013 and 2017



E7. Prescription History in the CSMD among All Drug Overdose Deaths

**Percent who filled any prescription in the TN CSMD within 365 days of death by type of overdose death by year (n = 5,511 total)**

| Overdose Death | 2013 (n = 1,166) | 2014 (n = 1,263) | 2015 (n = 1,451) | 2016 (n = 1,631) | Percent Difference |
|---|---|---|---|---|---|
| **All Drug** | 78 | 75 | 72 | 66 | -12 |
| **Opioid** | 81 | 78 | 75 | 67 | -14 |
| **Prescription Opioids** (Natural, semi-synthetic, and synthetic) | 81 | 81 | 77 | 70 | -11 |
| **Pain Relievers** (per CDC definition, includes methadone) | 82 | 82 | 80 | 73 | -9 |
| **Heroin** | 63 | 59 | 62 | 57 | -6 |
| **Fentanyl** | 89 | 75 | 67 | 62 | -27 |
| **Methadone** | 79 | 80 | 70 | 62 | -17 |
| **Benzodiazepine** | 83 | 83 | 80 | 72 | -11 |
| **Opioid and Benzodiazepine** | 84 | 85 | 81 | 72 | -12 |

**Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data Sources: TN Death Statistical files, Controlled Substance Monitoring Database.**

**Percent who filled any prescription in the TN CSMD within 60 days of death by type of overdose death by year (n = 5,511 total)**

| Overdose Death | 2013 (n = 1,166) | 2014 (n = 1,263) | 2015 (n = 1,451) | 2016 (n = 1,631) | Percent Difference |
|---|---|---|---|---|---|
| **All Drug** | 61 | 58 | 54 | 47 | -14 |
| **Opioid** | 65 | 61 | 58 | 48 | -17 |
| **Prescription Opioids** (Natural, semi-synthetic, and synthetic) | 66 | 65 | 62 | 51 | -15 |
| **Pain Relievers** (per CDC definition, includes methadone) | 66 | 66 | 65 | 57 | -9 |
| **Heroin** | 38 | 36 | 39 | 34 | -4 |
| **Fentanyl** | 77 | 62 | 45 | 36 | -41 |
| **Methadone** | 58 | 61 | 49 | 43 | -15 |
| **Benzodiazepine** | 69 | 68 | 68 | 55 | -14 |
| **Opioid and Benzodiazepine** | 70 | 70 | 70 | 56 | -14 |

**Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data Sources: TN Death Statistical files, Controlled Substance Monitoring Database.**

## Percent who filled a prescription for an opioid or benzodiazepine in the TN CSMD within 60 days of death by type of overdose death by year (n = 5,511 total)

| | Opioid Prescription Filled | | | | | Benzodiazepine Prescription Filled | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Overdose Death** | 2013 | 2014 | 2015 | 2016 | Percent Difference | 2013 | 2014 | 2015 | 2016 | Percent Difference |
| **All Drug** | 52 | 48 | 45 | 37 | -15 | 41 | 36 | 34 | 28 | -13 |
| **Opioid** | 57 | 52 | 48 | 40 | -17 | 43 | 38 | 36 | 28 | -15 |
| **Prescription Opioids** (Natural, semi-synthetic, and synthetic) | 59 | 57 | 52 | 42 | -17 | 44 | 42 | 40 | 31 | -13 |
| **Pain Relievers** (per CDC definition, includes methadone) | 59 | 58 | 55 | 49 | -10 | 43 | 43 | 43 | 36 | -7 |
| **Heroin** | 25 | 28 | 27 | 26 | 1 | 16 | 20 | 20 | 18 | 2 |
| **Fentanyl** | 68 | 51 | 37 | 27 | -41 | 53 | 38 | 24 | 17 | -36 |
| **Methadone** | 50 | 49 | 30 | 32 | -18 | 33 | 44 | 40 | 29 | -4 |
| **Benzodiazepine** | 58 | 55 | 57 | 43 | -15 | 56 | 52 | 53 | 39 | -17 |
| **Opioid and Benzodiazepine** | 59 | 59 | 59 | 45 | -14 | 56 | 52 | 54 | 40 | -16 |

**Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data Sources: TN Death Statistical files, Controlled Substance Monitoring Database.**

## Percent who filled a prescription for an opioid or benzodiazepine in the TN CSMD within 180 days of death by type of overdose death by year (n = 5,511 total)

| | Opioid Prescription Filled | | | | | Benzodiazepine Prescription Filled | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Overdose Death** | 2013 | 2014 | 2015 | 2016 | Percent Difference | 2013 | 2014 | 2015 | 2016 | Percent Difference |
| **All Drug** | 63 | 60 | 56 | 49 | -14 | 47 | 43 | 40 | 34 | -13 |
| **Opioid** | 66 | 64 | 59 | 51 | -15 | 49 | 45 | 42 | 35 | -14 |
| **Prescription Opioids** (Natural, semi-synthetic, and synthetic) | 68 | 69 | 62 | 54 | -14 | 50 | 48 | 45 | 37 | -13 |
| **Pain Relievers** (per CDC definition, includes methadone) | 69 | 69 | 65 | 60 | -9 | 51 | 49 | 48 | 43 | -8 |
| **Heroin** | 33 | 42 | 41 | 38 | 5 | 21 | 26 | 26 | 24 | 3 |
| **Fentanyl** | 74 | 67 | 51 | 39 | -35 | 62 | 46 | 30 | 22 | -40 |
| **Methadone** | 60 | 62 | 48 | 49 | -11 | 42 | 49 | 43 | 34 | -8 |
| **Benzodiazepine** | 68 | 71 | 66 | 55 | -13 | 63 | 59 | 58 | 46 | -17 |
| **Opioid and Benzodiazepine** | 69 | 74 | 68 | 57 | -12 | 64 | 59 | 59 | 46 | -18 |

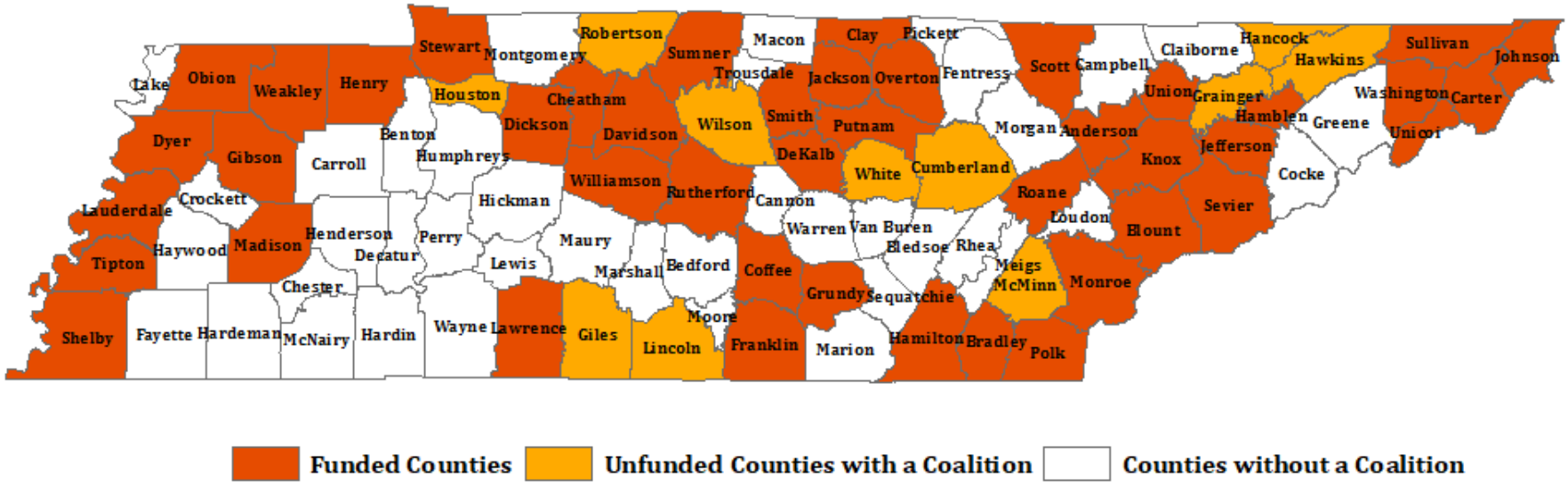
**Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents. Data Sources: TN Death Statistical files, Controlled Substance Monitoring Database.**

**Percent who filled a prescription for an opioid or benzodiazepine in the TN CSMD within 365 days of death by type of overdose death by year (n = 5,511 total)**

| Overdose Death | 2013 | 2014 | 2015 | 2016 | Percent Difference | 2013 | 2014 | 2015 | 2016 | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|
| **All Drug** | 71 | 69 | 65 | 59 | -12 | 50 | 48 | 45 | 38 | -12 |
| **Opioid** | 75 | 73 | 68 | 61 | -14 | 53 | 50 | 46 | 38 | -15 |
| **Prescription Opioids** (Natural, semi-synthetic, and synthetic) | 77 | 77 | 71 | 63 | -14 | 54 | 54 | 49 | 41 | -13 |
| **Pain Relievers** (per CDC definition, includes methadone) | 77 | 78 | 73 | 67 | -10 | 54 | 55 | 52 | 47 | -7 |
| **Heroin** | 44 | 51 | 52 | 50 | 6 | 25 | 32 | 29 | 26 | 1 |
| **Fentanyl** | 85 | 70 | 59 | 53 | -32 | 64 | 48 | 34 | 25 | -39 |
| **Methadone** | 72 | 73 | 55 | 56 | -16 | 43 | 58 | 46 | 37 | -6 |
| **Benzodiazepine** | 77 | 78 | 73 | 63 | -14 | 66 | 64 | 61 | 50 | -16 |
| **Opioid and Benzodiazepine** | 78 | 81 | 74 | 64 | -14 | 67 | 65 | 62 | 50 | 17 |

**Analysis conducted by the Office of Informatics and Analytics, TDH (last updated September 2017). Limited to TN residents.**

## E8. Anti-Drug Coalitions in Tennessee, 2017



## E9. Age-specific Counts and Rates by Type of Drug Overdose Death among TN residents ≥15 years, 2012-2016

| All Drug Overdose Deaths | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 65 | 876,616 | 7.41 | 64 | 881,079 | 7.26 | 68 | 885,935 | 7.68 | 87 | 884,197 | 9.84 | 116 | 876,855 | 13.23 |
| 25-34 | 197 | 844,066 | 23.34 | 196 | 846,372 | 23.16 | 240 | 858,325 | 27.96 | 252 | 872,233 | 28.89 | 342 | 892,054 | 38.34 |
| 35-44 | 277 | 841,915 | 32.90 | 279 | 841,476 | 33.16 | 296 | 840,148 | 35.23 | 349 | 837,242 | 41.68 | 347 | 831,284 | 41.74 |
| 45-54 | 322 | 910,875 | 35.35 | 341 | 902,043 | 37.80 | 395 | 896,731 | 44.05 | 409 | 894,910 | 45.70 | 465 | 894,419 | 51.99 |
| 55-64 | 160 | 822,636 | 19.45 | 216 | 832,204 | 25.96 | 196 | 842,266 | 23.27 | 254 | 855,183 | 29.70 | 278 | 866,723 | 32.07 |
| 65-74 | 35 | 536,160 | 6.53 | 41 | 561,923 | 7.30 | 41 | 586,298 | 6.99 | 57 | 607,692 | 9.38 | 65 | 628,409 | 10.34 |
| 75-84 | 20 | 275,958 | 7.25 | 18 | 281,615 | * | 20 | 288,262 | 6.94 | 27 | 295,124 | 9.15 | 9 | 302,936 | * |
| 85+ | 15 | 106,389 | * | 6 | 108,838 | * | 6 | 111,140 | * | 10 | 113,736 | * | 6 | 115,707 | * |

| All Opioid Overdose Deaths | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 46 | 876,616 | 5.25 | 49 | 881,079 | 5.56 | 48 | 885,935 | 5.42 | 68 | 884,197 | 7.69 | 86 | 876,855 | 9.81 |
| 25-34 | 150 | 844,066 | 17.77 | 146 | 846,372 | 17.25 | 195 | 858,325 | 22.72 | 204 | 872,233 | 23.39 | 288 | 892,054 | 32.29 |
| 35-44 | 188 | 841,915 | 22.33 | 197 | 841,476 | 23.41 | 213 | 840,148 | 25.35 | 259 | 837,242 | 30.93 | 279 | 831,284 | 33.56 |
| 45-54 | 198 | 910,875 | 21.74 | 206 | 902,043 | 22.84 | 264 | 896,731 | 29.44 | 295 | 894,910 | 32.96 | 298 | 894,419 | 33.32 |
| 55-64 | 88 | 822,636 | 10.70 | 126 | 832,204 | 15.14 | 123 | 842,266 | 14.60 | 165 | 855,183 | 19.29 | 189 | 866,723 | 21.81 |
| 65-74 | 18 | 536,160 | * | 24 | 561,923 | 4.27 | 13 | 586,298 | * | 31 | 607,692 | 5.10 | 38 | 628,409 | 6.05 |
| 75-84 | 6 | 275,958 | * | 4 | 281,615 | * | 4 | 288,262 | * | 8 | 295,124 | * | 4 | 302,936 | * |
| 85+ | 3 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 1 | 113,736 | * | 2 | 115,707 | * |

| Natural and Semi-Synthetic Overdose Deaths | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 24 | 876,616 | 2.74 | 31 | 881,079 | 3.52 | 24 | 885,935 | 2.71 | 30 | 884,197 | 3.39 | 40 | 876,855 | 4.56 |
| 25-34 | 94 | 844,066 | 11.14 | 92 | 846,372 | 10.87 | 114 | 858,325 | 13.28 | 102 | 872,233 | 11.69 | 125 | 892,054 | 14.01 |
| 35-44 | 129 | 841,915 | 15.32 | 137 | 841,476 | 16.28 | 133 | 840,148 | 15.83 | 155 | 837,242 | 18.51 | 144 | 831,284 | 17.32 |
| 45-54 | 142 | 910,875 | 15.59 | 149 | 902,043 | 16.52 | 181 | 896,731 | 20.18 | 195 | 894,910 | 21.79 | 210 | 894,419 | 23.48 |
| 55-64 | 65 | 822,636 | 7.90 | 85 | 832,204 | 10.21 | 90 | 842,266 | 10.69 | 128 | 855,183 | 14.97 | 128 | 866,723 | 14.77 |
| 65-74 | 14 | 536,160 | * | 18 | 561,923 | * | 7 | 586,298 | * | 20 | 607,692 | 3.29 | 27 | 628,409 | 4.30 |
| 75-84 | 4 | 275,958 | * | 2 | 281,615 | * | 4 | 288,262 | * | 6 | 295,124 | * | 3 | 302,936 | * |
| 85+ | 2 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 1 | 113,736 | * | 1 | 115,707 | * |

| Overdose Deaths Involving Methadone | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 10 | 876,616 | * | 4 | 881,079 | * | 4 | 885,935 | * | 3 | 884,197 | * | 2 | 876,855 | * |
| 25-34 | 36 | 844,066 | 4.27 | 19 | 846,372 | * | 19 | 858,325 | * | 13 | 872,233 | * | 15 | 892,054 | * |
| 35-44 | 29 | 841,915 | 3.44 | 27 | 841,476 | 3.21 | 16 | 840,148 | * | 23 | 837,242 | 2.75 | 33 | 831,284 | 3.97 |
| 45-54 | 18 | 910,875 | * | 22 | 902,043 | 2.44 | 20 | 896,731 | 2.23 | 14 | 894,910 | * | 20 | 894,419 | 2.24 |
| 55-64 | 7 | 822,636 | * | 13 | 832,204 | * | 12 | 842,266 | * | 11 | 855,183 | * | 9 | 866,723 | * |
| 65-74 | 0 | 536,160 | * | 1 | 561,923 | * | 0 | 586,298 | * | 3 | 607,692 | * | 3 | 628,409 | * |
| 75-84 | 0 | 275,958 | * | 0 | 281,615 | * | 0 | 288,262 | * | 0 | 295,124 | * | 0 | 302,936 | * |
| 85+ | 1 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 0 | 113,736 | * | 0 | 115,707 | * |

| Overdose Deaths Involving Heroin | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 10 | 876,616 | * | 9 | 881,079 | * | 15 | 885,935 | * | 19 | 884,197 | * | 26 | 876,855 | 2.97 |
| 25-34 | 13 | 844,066 | * | 21 | 846,372 | 2.48 | 51 | 858,325 | 5.94 | 67 | 872,233 | 7.68 | 85 | 892,054 | 9.53 |
| 35-44 | 14 | 841,915 | * | 13 | 841,476 | * | 34 | 840,148 | 4.05 | 57 | 837,242 | 6.81 | 68 | 831,284 | 8.18 |
| 45-54 | 6 | 910,875 | * | 13 | 902,043 | * | 27 | 896,731 | 3.01 | 43 | 894,910 | 4.80 | 49 | 894,419 | 5.48 |
| 55-64 | 2 | 822,636 | * | 7 | 832,204 | * | 20 | 842,266 | 2.37 | 16 | 855,183 | * | 28 | 866,723 | 3.23 |
| 65-74 | 0 | 536,160 | * | 0 | 561,923 | * | 0 | 586,298 | * | 3 | 607,692 | * | 3 | 628,409 | * |
| 75-84 | 0 | 275,958 | * | 0 | 281,615 | * | 0 | 288,262 | * | 0 | 295,124 | * | 1 | 302,936 | * |
| 85+ | 0 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 0 | 113,736 | * | 0 | 115,707 | * |

| Overdose Deaths Involving Fentanyl | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 0 | 876,616 | * | 3 | 881,079 | * | 4 | 885,935 | * | 24 | 884,197 | 2.71 | 35 | 876,855 | 3.99 |
| 25-34 | 0 | 844,066 | * | 12 | 846,372 | * | 14 | 858,325 | * | 42 | 872,233 | 4.82 | 114 | 892,054 | 12.78 |
| 35-44 | 1 | 841,915 | * | 12 | 841,476 | * | 17 | 840,148 | * | 42 | 837,242 | 5.02 | 69 | 831,284 | 8.30 |
| 45-54 | 2 | 910,875 | * | 14 | 902,043 | * | 25 | 896,731 | 2.79 | 38 | 894,910 | 4.25 | 42 | 894,419 | 4.70 |
| 55-64 | 1 | 822,636 | * | 7 | 832,204 | * | 6 | 842,266 | * | 19 | 855,183 | * | 28 | 866,723 | 3.23 |
| 65-74 | 0 | 536,160 | * | 5 | 561,923 | * | 2 | 586,298 | * | 3 | 607,692 | * | 5 | 628,409 | * |
| 75-84 | 0 | 275,958 | * | 0 | 281,615 | * | 0 | 288,262 | * | 1 | 295,124 | * | 0 | 302,936 | * |
| 85+ | 0 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 0 | 113,736 | * | 0 | 115,707 | * |

| Overdose Deaths Involving Opioids and Benzodiazepines | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
| Age Group (years) | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate | Count | Population | Crude Rate |
| 15-24 | 12 | 876,616 | * | 19 | 881,079 | * | 21 | 885,935 | 2.37 | 22 | 884,197 | 2.49 | 42 | 876,855 | 4.79 |
| 25-34 | 59 | 844,066 | 6.99 | 79 | 846,372 | 9.33 | 83 | 858,325 | 9.67 | 92 | 872,233 | 10.55 | 119 | 892,054 | 13.34 |
| 35-44 | 70 | 841,915 | 8.31 | 91 | 841,476 | 10.81 | 90 | 840,148 | 10.71 | 117 | 837,242 | 13.97 | 130 | 831,284 | 15.64 |
| 45-54 | 76 | 910,875 | 8.34 | 91 | 902,043 | 10.09 | 108 | 896,731 | 12.04 | 127 | 894,910 | 14.19 | 139 | 894,419 | 15.54 |
| 55-64 | 26 | 822,636 | 3.16 | 53 | 832,204 | 6.37 | 45 | 842,266 | 5.34 | 74 | 855,183 | 8.65 | 78 | 866,723 | 9.00 |
| 65-74 | 5 | 536,160 | * | 6 | 561,923 | * | 4 | 586,298 | * | 13 | 607,692 | * | 13 | 628,409 | * |
| 75-84 | 1 | 275,958 | * | 1 | 281,615 | * | 1 | 288,262 | * | 1 | 295,124 | * | 1 | 302,936 | * |
| 85+ | 0 | 106,389 | * | 0 | 108,838 | * | 0 | 111,140 | * | 1 | 113,736 | * | 0 | 115,707 | * |

# Appendix F: TN Drug Overdose Dashboard Presentations

TN Drug Overdose Dashboard went *live* on August 8, 2017

| Date | Audience | Description | Number of Participants |
|---|---|---|---|
| 08/08/2017 | Tennessee Association of Community Action. The TACA is made up of community groups who combat poverty within communities by removing the barriers to self-sufficiency clients may encounter. | Presented at the Tennessee Association of Community Action (TACA) quarterly meeting. Additional presenters:<br>• Shea Davis who presented on behalf of the TN Department of Mental Health & Substance Abuse Services (DMHSAS)<br>• Dr. Carrie Lawrence from Indiana University who presented on Scott County, IN. | 45 |
| 08/09/2017 | Tennessee Department of Health's Office of Informatics & Analytics, Controlled Substance Monitoring Database, Division of Strategic Technology Solutions (STS), Vanderbilt University and DMHSAS | Open house featuring posters, data briefs, dashboard, website, binder detailing methodology | 25 |
| 09/11/2017 | TN Department of Health | Dashboard Training | 100+ |
| 09/13/2017 | Roane County Anti-Drug Coalition | Dashboard Training | 25 |
| 10/03/2017 | Anti- Drug Coalitions hosted by Prevention Alliance of Tennessee (PAT) | Dashboard Training Webinar | 60+ |
| 10/04/2017 | Carter County Drug Prevention Coalition | Dashboard Training | 15 |
| 10/25/2017 | Chattanooga Medical Forum (surrounding counties included) hosted by the Hamilton County Coalition | Dashboard Training. Additionally, Susan Miller and Charlotte Cherry served on panel during Question & Answer session. | 30 |
| 11/01/2017 | Annual Statewide CHS County/Regional Directors Meeting | Dashboard Training | 150 |
| 11/09/2017 | Sullivan County Anti-Drug Coalition Meeting | Dashboard Training | 15 |
| 11/15/2017 | Obion County Prevention Coalition | Dashboard Training | 20 |
| 12/18/2017 | Monroe County Health Council Prevention & Wellness Coalition | Dashboard Training<br>Additional presentations included:<br>• Drug Endangered Children Task Force<br>• State Drug Overdose Dashboard<br>• Opioid Drug Trends and Threats by Tennessee Bureau of Investigation<br>• Rapid Response Overdose Mapping System<br>• Regional Overdose Prevention Training & Narcan Disbursement | 40 |
| | | | Total 525 |