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September 15, 2016

Steven T. James
House Clerk
State House Room 145
Boston, MA 02133

William F. Welch
Senate Clerk
State House Room 335
Boston, MA 02133

Dear Mr. Clerk,

The Massachusetts Department of Public Health (DPH) is pleased to submit the attached initial report on the opioid overdose study authorized by Chapter 55 of the Acts of 2015.

The current opioid epidemic affecting our Commonwealth's communities has taken a record number of lives in each of the last four years. Opioid Use Disorder is a complex chronic disease, and this opioid epidemic is a complex and persistent problem that will not be solved through a single solution. Analytic work is ongoing, and much is yet to be learned from this effort, however, the findings of this initial report can immediately inform our collective work with new insight into overdose-related deaths and the relative risks faced by different populations.

I would like to acknowledge that this work has required a significant collaborative effort from many government agencies. To this end, we are truly grateful to the many partners which have assisted DPH in this work so far. This effort highlights government's ability to work collaboratively towards efficiently solving complex and urgent problems. With the effort of legal, technical, and analytical teams across seven state agencies (Department of Public Health, EOHHS IT, the Office of the Chief Medical Examiner, the Department of Correction, MassHealth, the Center for Health Information and Analysis, and MassIT), Massachusetts has

been able to develop a novel data model that allows for simultaneous analysis of 10 datasets with information relevant to opioid deaths. The goodwill of all parties has been a hallmark of this ongoing work.

I would also like to express my appreciation for the continued opportunity the Legislature has provided the Department of Public Health. The analytic approach authorized by Chapter 55 has enabled Massachusetts to serve as a national example for the possibilities of public health's ability to leverage data warehousing to respond to pressing policy and health concerns by allowing existing data to be leveraged in new and innovative ways to support policy development and decision making, and to allocate resources more efficiently and effectively. To this end, other states have already engaged the Department in discussions about the technical aspects of this project, and I hope that this will serve as a model for how complex problems can be tackled in the future.

Let me once again express how grateful I am for the Legislature's commitment to better understanding the root causes of this opioid epidemic by allowing us to continue this important work. I look forward to continuing to share the results of our analyses, and to our continued partnership in addressing this opioid epidemic.

Sincerely,

Monica Bharel, MD, MPH
Commissioner
Department of Public Health

Charles D. Baker
Governor

Karyn Polito
Lieutenant Governor

Marylou Sudders
Secretary

Monica Bharel, MD, MPH
Commissioner

An Assessment of Opioid-Related Deaths in Massachusetts (2013 – 2014)

September 2016

Table of Contents

Legislative Mandate

The following report is hereby issued pursuant to Chapter 55 of the Acts of 2015, as amended by Chapter 133 of the Acts of 2016 as follows:

Notwithstanding any general or special law to the contrary, the secretary of health and human services, in collaboration with the department of public health, shall conduct or provide for an examination of the prescribing and treatment history, including court-ordered treatment or treatment within the criminal justice system, of persons in the commonwealth who suffered fatal or nonfatal opiate overdoses in calendar years 2013 to 2015, inclusive. Any report or supplemental reports resulting from this examination shall provide any data in an aggregate and de-identified format.

Notwithstanding any general or special law to the contrary, to facilitate the examination, the department shall request, and the relevant offices and agencies shall provide, information necessary to complete the examination from the division of medical assistance, the executive office of public safety and security, the center for health information and analysis, the office of patient protection and the chief justice of the trial court, which may include, but shall not be limited to: data from the prescription drug monitoring program; the all-payer claims database; the criminal offender record information database; and the court activity record information. To the extent feasible, the department shall request data from the Massachusetts Sheriffs Association, Inc. relating to treatment within houses of correction.

Not later than 1 year from the effective date of this act, the secretary of health and human services shall publish a report on the findings of the examination including, but not limited to: (i) instances of multiple provider episodes, meaning a single patient having access to opiate prescriptions from more than 1 provider; (ii) instances of poly-substance access, meaning a patient having simultaneous prescriptions for an opiate and a benzodiazepine or for an opiate and another drug which may enhance the effects or the risks of drug abuse or overdose; (iii) the overall opiate prescription history of the individuals, including whether the individuals had access to legal prescriptions for opiate drugs at the time of their deaths; (iv) whether the individuals had previously undergone voluntary or involuntary treatment for substance addiction or behavioral health; (v) whether the individuals had attempted to enter but were denied access to treatment for substance addiction or behavioral health; (vi) whether the individuals had received past treatment for a substance overdose; (vii) whether any individuals had been previously detained or incarcerated and, if so, whether the individuals had received treatment during the detention or incarceration.

The report shall be filed with the clerks of the senate and house of representatives, the house and senate chairs of the joint committee on mental health and substance abuse, the joint committee on public health, the joint committee on health care financing and the house and senate committees on ways and means. The secretary of health and human services may publish supplemental reports on the trends identified through its examination; provided, however, that any supplemental report shall be filed not later than July 1, 2017 and shall be filed with the clerks of the senate and house of representatives, the house and senate chairs of the joint committee on mental health and substance abuse, the joint

committee on public health, the joint committee on health care financing and the house and senate committees on ways and means.

Notwithstanding any general or special law to the contrary, the executive office of health and human services may contract with a non-profit or educational entity to conduct data analytics on the data set generated in the examination, provided that the executive office shall implement appropriate privacy safeguards.

Executive Summary

Background

Since 2000, opioid-related deaths have increased in Massachusetts by 350%. The recent rate of increase is several times faster than anything seen before[1] with every community in Massachusetts impacted by the current opioid epidemic. However, beneath this statewide impact, data indicates that some areas of the Commonwealth have been disproportionately impacted by this opioid epidemic. In particular, southeastern Massachusetts and Essex County have been inordinately affected. Just as communities are differentially impacted by the current opioid epidemic, population groups are also differently burdened. Opioid-related death rates are highest among younger males – a fact that is similar in all states.[2] Opioid-related death rates are also higher among those who have recently been released from Massachusetts prisons, those who have obtained opioid prescriptions from multiple pharmacies, and those who have obtained prescription opioids in combination with other scheduled medications.

As part of a multi-faceted effort to address this unprecedented public health crisis, Chapter 55 of the Acts of 2015 (Chapter 55) was passed by the Massachusetts Legislature and signed into law by Governor Charles D. Baker in August 2015. This new law permits the linkage and analysis of existing data across state government in order to better guide policy development and programmatic decision-making to successfully tackle the current opioid epidemic. Chapter 55 articulates seven questions to be addressed in this initial report. Detailed responses to each question can be found in Appendix A. In addition, Chapter 55 permits examinations beyond these seven questions, providing the Department of Public Health (DPH) an opportunity to build an even more comprehensive picture of the current opioid crisis. To this end, DPH has connected ten datasets managed by five state agencies to build a data warehouse structure – a concept viewed by national experts as the future of successful public health.

While this initial report includes the first findings from the cross-agency analyses of these ten datasets, analytic work is ongoing, and much is yet to be learned from this nationally-leading effort. Contained within this report are descriptions of four specific analyses that directly respond to questions posed by Chapter 55, providing the state with important new insights into the profile of overdose-related deaths and the relative risks faced by the Commonwealth's diverse populations. The importance of these findings has prompted the Department to issue initial recommendations to inform policy and response efforts across the state and region.

Key Findings

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[1] Accessed at http://www.mass.gov/eohhs/docs/dph/quality/drugcontrol/county-level-pmp/data-brief-overdose-deaths-may-2016.pdf

[2] Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2014 on CDC WONDER Online Database, released 2015. Data are from the Multiple Cause of Death Files, 1999-2014, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10.html .

Prescription Drugs Fuel This Epidemic, but Illegally-Obtained Substances More Closely Linked to Overdose Deaths: Using these data, it was determined that illegally-obtained substances are much more frequently present in post-mortem toxicology than prescription drugs (i.e., a Schedule II-III opioids, or benzodiazepines). While prescription drug use can result in addiction and may increase the long-term risk of death, illegal drugs appear more likely to be the direct cause of death. As a result, increasing the availability of harm reduction strategies and interventions that target Heroin, Fentanyl, and polysubstance use (especially opioid use concurrent with benzodiazepine and/or Cocaine use) could significantly reduce the opioid-related death rate.

Medication Assisted Treatment Reduces the Risk of Fatal Opioid Overdose: Another key finding from these data is that receiving evidence-based opioid agonist treatment following a nonfatal overdose was associated with a reduced risk of a subsequent fatal opioid overdose. This suggests that overdose survivors have a short window of opportunity after a nonfatal overdose to reduce their risk of death by undergoing an evidence-based medication-assisted treatment (MAT). A comprehensive plan for delivering evidence-based MAT, such as buprenorphine or methadone treatment, to treat opioid use disorder for those with high overdose risk could significantly lower the death rate. This report only includes data for state-funded opioid agonist treatment (i.e. Buprenorphine or Methadone). Work is ongoing to examine risk reductions associated with additional MATs including naltrexone.[3]

Women are More Likely than Men to Experience a Fatal Overdose Due to Prescription Opioid Use: While men were found to be significantly more likely to die from any opioid-related overdose, the results of this study indicate that women are more likely than men to die of a prescription opioid-related overdose. Women were more likely than men to both obtain Schedule II-III opioids and to have Schedule II-III opioids present in post-mortem toxicology following an opioid-related overdose death. While legally- and illegally-obtained opioids pose a risk for men and women alike, prescribers and pharmacists should be educated to utilize the Prescription Drug Monitoring Database (PDMP) through the Massachusetts Prescription Awareness Tool (MassPAT) in order to identify any active or past prescriptions for their patients and to provide coordinated care and overdose risk reduction.

Individuals Who Have Recently Been Released from Massachusetts Prisons are 56 Times as Likely to Die from an Opioid Related Overdose: Those who have recently been released from Massachusetts prisons have a short-term risk of death from opioid overdose that is greater than 50 times the risk for the general public. 25% of Massachusetts prison inmates received treatment during their incarceration, and there was not a notable reduction in risk of fatal overdose in those that received treatment. To further reduce the opioid-related death rate, additional focus should be paid to those being released from Massachusetts prisons, and treatment opportunities should be standardized regardless of setting.

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[3] Naltrexone, also known as Vivitrol, is a Schedule VI drug. As such, it is not captured in the PDMP. In future work, All Payer Claims Database (APCD) data will be used to assess the potential risk reduction associated with Vivitrol use.

Key Findings	Recommendations
FINDING 1 – Individuals who died from opioid-related overdoses are much more likely to have an illegally-obtained substance (i.e., not Schedule II-III opioid) present in post-mortem toxicology	Harm reduction strategies and other interventions that address Heroin, Fentanyl, and polysubstance use should be increased, expanded, and enhanced.
FINDING 2 – Following nonfatal overdoses, people on opioid agonist treatment (i.e., medications that block the effect of opioids like Methadone and buprenorphine) are significantly less likely to die	Strategies for making medications for opioid use disorders more accessible to individuals who experience a nonfatal opioid overdose should be prioritized.
FINDING 3 – Women are significantly more likely than men to receive opioids from 3 or more prescribers and obtain them from 3 or more pharmacies.	MassPAT should be leveraged by prescribers and pharmacists as a decision support tool to inform clinical decision-making. Also, prescribers and pharmacists should be educated about their own personal biases.
FINDING 4 – The risk of opioid overdose death following incarceration is 56 times higher than for the general public.	MAT and overdose prevention services should be expanded in correctional facilities, and access to post-incarceration medical care and substance use prevention and treatment should be put in place prior to release.

Importantly, in addition to providing insight into the current opioid epidemic, this effort also marks the beginning of how government, academia, the health care system, and private industry can and should collaborate to ask and answer complex questions. DPH is no longer asked to simply track the incidence of disease. Instead, public health policymakers, analysts, and researchers are faced with more complex questions than ever before. Increasingly, state leadership, stakeholders, and the public are calling upon DPH to assess the effectiveness of its policies and programming and to adjust accordingly. The Department's ability to engage academic partners and private industry to support surveillance and evaluation activities will be crucial, and collaborative, data-driven efforts such as this should become standard practice in Massachusetts and beyond.

To this end, a virtual Data Warehouse – a virtual platform that links, stores, and allows for the analysis of datasets from multiple sources – should continue to be developed and expanded. Similarly to how successful businesses leverage big data to identify market opportunities, evaluate initiatives, and inform their operational and strategic decisions, a virtual Data Warehouse can serve as a business intelligence tool that would enable DPH to more efficiently and effectively target its resources, and to more precisely evaluate its programming. Furthermore, DPH will be able to support researchers and industry by being able to quickly provide these partners with information and analyses from multiple public and private data systems. Information from vital records (e.g. birth and death records), insurance

claims data, public health programs, research and educational institutions, hospitals, and other clinical partners can be aligned and examined to provide DPH, academics, and industry with answers to critical questions about health outcomes, program effectiveness, and health care costs. These and other examples – all fueled by data warehousing technology – represent public health of tomorrow.

Introduction

Addiction is a complex chronic disease characterized by compulsive alcohol/drug use and/or behaviors, cravings, and continued use despite harmful consequences. Nearly one in ten Americans over the age of 12 are classified as having a substance use disorder.[3] Among brain disorders, addiction incurs greater economic costs than Alzheimer's disease, stroke, Parkinson's disease, or head and neck injury. Addiction is also the most costly neuropsychiatric disorder.[4] According to the National Institute on Drug Abuse,[5,6] the overall cost of substance abuse in the United States exceeds half a trillion dollars, including health- and crime-related expenses, as well as losses in productivity. While the term addiction includes alcohol and drug abuse, this report focuses on opioid addiction and its impact on premature death in Massachusetts.

The consequences of addiction extend far beyond just cost. Specifically, addiction harms individuals, as well as their families, friends, and communities. Addiction to substances, like opioids, also put people at risk for the development of health problems, including life-threatening infections such as HIV and hepatitis, cirrhosis, cognitive decline, overdose, unplanned pregnancy, family disintegration, domestic violence, criminal behavior, child abuse, and death.[7]

Massachusetts is particularly affected by opioids and opioid addiction. As in other states, the 1990s and 2000s were marked with substantial increases in prescribing of opioids for acute and chronic pain. This increased access to prescription opioids has been followed by increased availability of Heroin. According to a 2013 Drug Enforcement Administration (DEA) report, the reported availability of Heroin has increased significantly from 2007 to 2013 in New England.[8] A decade ago, the most prevalent substance reported to the Bureau of Substance Abuse Services (BSAS) at the time of admission for addiction treatment in Massachusetts was alcohol. In 2015, the most prevalent reported drugs were opioids. The percentage of BSAS admissions that were opioid-related increased from 31% in 2000 to 55% in 2014.[9] The Health Policy Commission has reported similar substantial increases over the same time period for Massachusetts emergency department visits and hospitalizations. [10,11]

Center for Behavioral Health Statistics and Quality. (2015). Behavioral health trends in the United States: Results from the 2014 Nat

ional Survey on Drug Use and Health (HHS Publication No. SMA 15-4927, NSDUH Series H-50). Retrieved from http://www.samhsa.gov/ data/

rugabuse.gov/publications/drugfacts/workplace --- resources

[6] Accessed at https://www.nlm.nih.gov/medlineplus/magazine/issues/spring07/articles/spring07pg14-17.html) .

[7] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders: **DSM**-**5**. Washington, D.C: American Psychiatric Association.

[8] Accessed at http://www.dea.gov/resource-center/DIR-017-13%20NDTA%20Summary%20final.pdf, pg. 7

[9] This includes both Heroin and other opioids.

[10] Accessed at https://www.bostonglobe.com/metro/2016/03/27/massachusetts-hospital-visits-for-opioid-abuse-soar/GGRehpwvyhY5OEea1bWO2J/story.htm

[11] Accessed at: http://www.bchumanservices.net/library/2016/04/Health-Policy-Commission-3-23-16-Opioid-Prelim.-Data-Presentation.pdf

Nationally, and in Massachusetts, there has been a dramatic increase in fatal and nonfatal opioid overdoses since 2000.[12] In May 2016, DPH reported that there were at least 1,379 confirmed opioid-related deaths in Massachusetts during 2015.[13] In comparison, there were one-quarter as many confirmed opioid-related deaths (338) in the year 2000. In 2013-2014, opioid-related deaths occurred in two-thirds of the communities in Massachusetts. While the opioid crisis has impacted every community in Massachusetts in some fashion (e.g., deaths, nonfatal overdoses, or disruptions to marriages, families, and neighborhoods), there are clearly areas that have been hit harder than others. The contrast between the community-level map from 2000 and from 2013-2014 (Figure INTR.1) clearly shows the increase in the number of communities with opioid-related deaths over a span of 15 years. Annual figures for confirmed and estimated cases can be found in Figure INTR.2. The number of confirmed unintentional opioid overdose deaths for 2015 (n=1531) represents an 18% increase over 2014 (n=1294), and the 2014 number (n=1294) represents a 41% increase over cases for 2013 (n=918). In order to obtain timelier estimates of the total number of opioid overdose deaths in Massachusetts - confirmed and probable - DPH used predictive modeling techniques for all cases not yet finalized by the Office of the Chief Medical Examiner (OCME).

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[12] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/stop-addiction/current-statistics.html
[13] This report includes confirmed fatal Opioid-overdoses from 2014 – 2015 (n=2,192)

Figure INTR.1: Opioid deaths in Massachusetts 2000 and 2013 – 2014

Annual Opioid-Related Death Rate by Municipality (2000)
(per 10,000 Adults Age 18 to 64)

County boundary
Crude opioid death rate
0
0.1 - 5
5.1 - 10
10.1 - 20
20.1 - 50

0   12.5   25   50 Miles
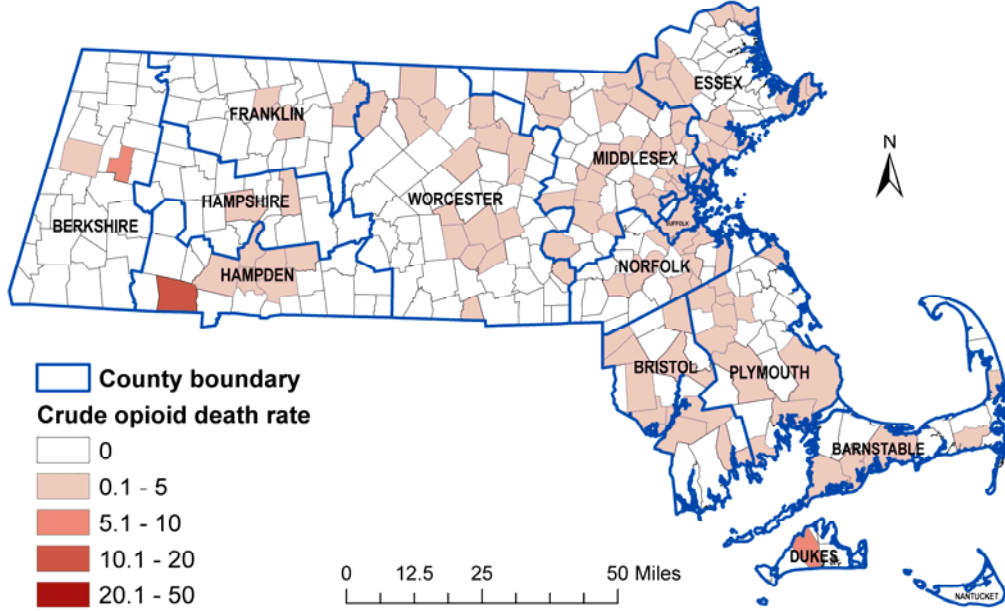
Annual Opioid-Related Death Rate by Municipality (2013-2014)
(per 10,000 Adults Age 18 to 64)

County boundary
Crude opioid death rate
0
0.1 - 5
5.1 - 10
10.1 - 20
20.1 - 50
>50

0   12.5   25   50 Miles
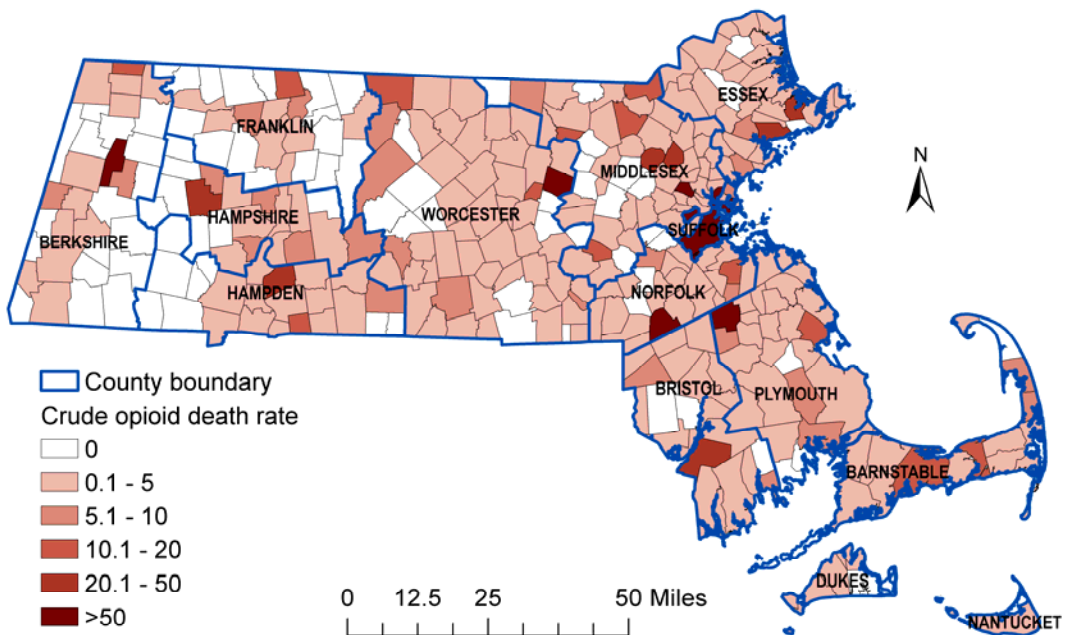
Figure INTR.2: Confirmed and estimated opioid deaths in Massachusetts between 2000 and 2015

Opioid-Related Deaths, Unintentional/Undetermined
Massachusetts: 2000-2015

Legend: ■ Confirmed ■ Estimated

Year	Number of deaths
2000	338
2001	468
2002	429
2003	549
2004	456
2005	525
2006	615
2007	614
2008	561
2009	599
2010	526
2011	603
2012	668
2013	911
2014	1,122 (Confirmed), 1,196 (Estimated)
2015	1,379 (Confirmed), 1,526 (Estimated)
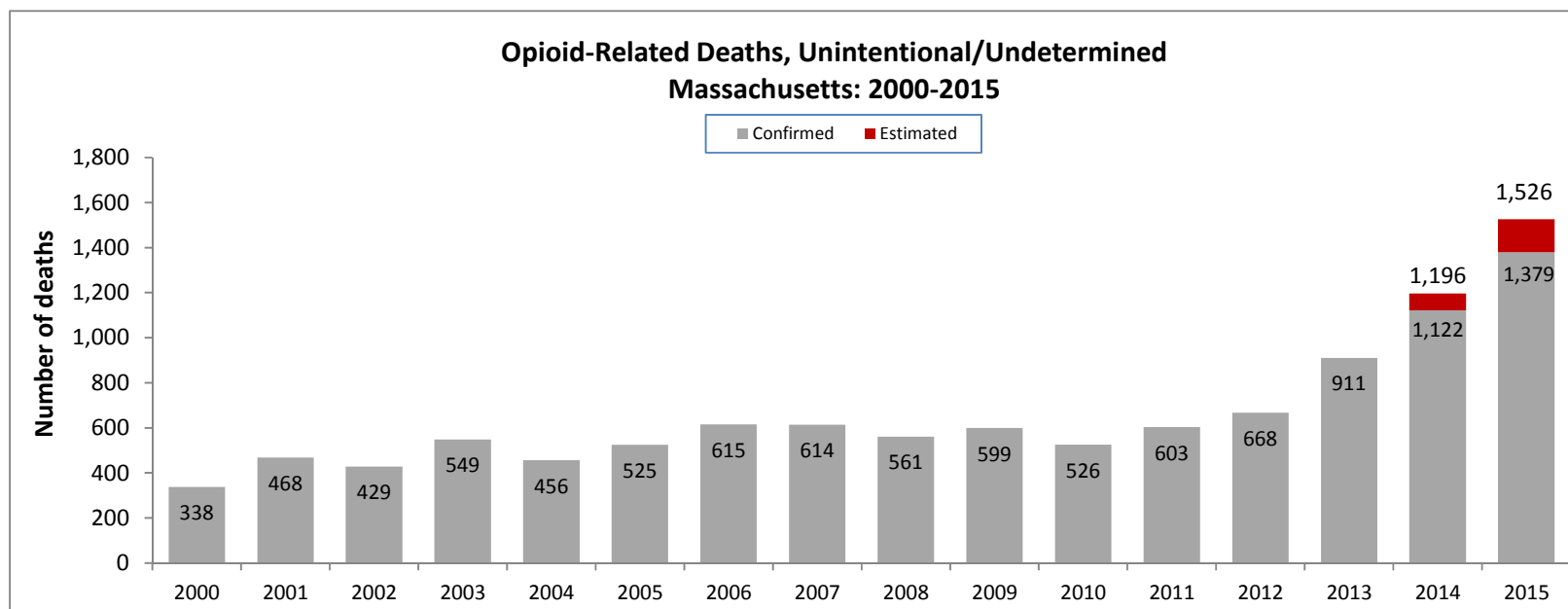
Note: Counts for 2000 – 2013 are complete as of the date that the state's statistical file was closed. Each year, a small number of cases receive a cause of death after the file is closed.

Unintentional poisoning/overdose deaths combine unintentional and undetermined intents to account for a change in death coding that occurred in 2005. Suicides are excluded from this analysis.

Opioids include Heroin, opioid-based prescription painkillers, and other unspecified opioids.

Cases were defined using the International Classification of Disease (ICD-10) codes for mortality. The following codes were selected from the underlying cause of death field to identify poisonings/overdoses: X40-X49, Y10-Y19. All multiple cause of death fields were then used to identify an opioid-related death: T40.0, T40.1, T40.2, T40.3, T40.4, and T40.6.

This report tracks all opioid-related overdoses due to difficulties in reporting Heroin-associated overdoses separately. Many deaths related to Heroin are not specifically coded as such due to the fast metabolism of Heroin into morphine.

To maintain consistency with NCHS reporting, the ICD-10 code F11.1 is not included, which may include opioid-related overdose death.

Just as communities are differentially affected by the opioid crisis, population groups are also affected differentially. While death rates have increased for virtually every population group, the rates are highest among younger males – a fact that is similar in all states.[14] In 2013-2014, 76% of opioid overdose deaths occurred in people under the age of 50. Furthermore, men of age 18 to 34 had opioid-related death rates nearly three times higher than women of the same age. For additional detail, see Table INTR.1.

Table INTR.1: Massachusetts Opioid Annual Death Rate (2013-2014 average)							
	Female			Male			
Age group	Number of opioid death	Percent opioid death among all deaths	Death Rate (10,000)	Number of opioid death	Percent opioid death among all deaths	Death Rate (10,000)	Male to Female Rate Ratio
18-24	49	28.5%	0.71	145	25.6%	2.12	2.98
25-34	158	32.4%	1.79	493	40.6%	5.72	3.20
35-49	253	14.5%	1.80	566	19.4%	4.22	2.34
50-64	178	3.0%	1.29	313	3.4%	2.44	1.89
65+	20	0.04%	0.18	15	0.04%	0.19	1.03
Total	658	1.2%	1.21	1532	3.1%	3.09	2.56

Potentially masked by familiar trends are other embedded trends about age and gender that this unique collection of data has allowed us to examine. Those trends are reported in subsequent sections of this report.

As stated above, opioid-related deaths began increasing very sharply in 2012.[15] While this report will not make causal statements about this increase, it will compare and contrast related trends within the same period. Two such trends are cited here. First, the number of opioids prescribed to residents of Massachusetts increased roughly 7% per year since 2000.[16] There was, however, no sharp increase in prescribed opioids beginning in 2012. In contrast, recent toxicology data suggest that the increased

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[14] Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2014 on CDC WONDER Online Database, released 2015. Data are from the Multiple Cause of Death Files, 1999-2014, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10.html .

[15] Accessed at http://www.mass.gov/eohhs/docs/dph/quality/drugcontrol/county-level-pmp/data-brief-overdose-deaths-may-2016.pdf

[16] Unpublished data from analysis of Massachusetts death records between 2000 and 2015 managed by the Registry of Vital Records and Statistics adjusted for population growth.

presence of Fentanyl in post-mortem cases roughly matches the increase in opioid-related deaths. Fentanyl is a powerful opioid that can be prescribed for pain management, but it can also be illicitly obtained either on its own, or mixed with Heroin.[17,18] Fentanyl, produced and sold illicitly as part of the Heroin supply, has become increasingly incorporated into Heroin supplies throughout the United States, but particularly in Massachusetts.[19,20] Toxicology data from post-mortem cases indicates that Fentanyl was present in blood, urine, and tissue samples in increasing numbers from 2013 through 2015. In 2015, 57% of toxicology samples tested positive for Fentanyl while the number was less than half that in 2013.[21]

These findings hint at underlying causes to the increasing opioid-related death rate, but more complex analyses are required to more firmly establish the links between numerous factors that might play important roles. The Chapter 55 effort has brought together a unique collection of datasets to gain a deeper understanding of the factors driving the crisis. To our knowledge, no state has captured as much data in one place to examine what is a national crisis. Four initial, cutting edge analyses are reported in the sections that follow. Further analysis is underway. While these findings are important, it is equally important to acknowledge that the sharp increase in opioid-related deaths has also motivated stakeholders across the Commonwealth to collaborate in an effort to better understand the risk factors that contribute to the increase in deaths, and how to collectively identify public health strategies to help reduce opioid-related death rates moving forward.

Key Takeaways

- The number of opioid-related deaths has increased 350% in 15 years
- The rate of opioid-related overdose deaths has risen sharply since 2011
- Solutions will require collaboration across stakeholders
- Analyzing linked datasets is the best way to understand the factors underlying the crisis

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[17] Accessed at: https://www.dea.gov/divisions/hq/2016/hq061016.shtml
[18] Accessed at: http://www.cdc.gov/drugoverdose/opioids/fentanyl.html
[19] For more information: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6450a3.htm
[20] The CDC alert can be found at: http://emergency.cdc.gov/han/han00384.asp
[21] Unpublished data from analysis of Massachusetts toxicology reports managed by the Office of the Chief Medical Examiner.

Report Organization

Chapter 55 of the Acts of 2015 specifically lists seven questions pertaining to fatal opioid overdoses. Detailed examinations of these questions are included. This exercise in data linking across relevant and available datasets in Massachusetts allows us to identify systems that served individuals who died of a fatal opioid overdose prior to their death (e.g. health care settings, or criminal justice system). By identifying these points of contact, this information may shed light on future interventions to prevent opioid overdoses. The toxicology reports from the decedents may shed some light on some details of the death; however, looking back at the systems that served these individuals prior to overdose is also critical. By linking across systems, it is possible to know whether an individual had an ambulance-related event reported to the Massachusetts Ambulance Trip Record Information System (MATRIS), any prescriptions for opioid medications recorded in the Prescription Drug Monitoring Program (PDMP), contact with the healthcare system via BSAS or in the hospitalization database (Case Mix) or All Payer Claims Database (APCD), or criminal justice involvement through the Department of Correction (DoC). The body of this report describes four analyses performed with data from the ten datasets. Those analyses can be found in the section that immediately follows.

The reader is encouraged to examine the appendices as well. Please refer to Appendix A for detailed answers to the seven questions specified in Chapter 55. Among the questions were requests for information about the use of multiple prescribers, poly-prescription use, voluntary and involuntary treatment, and post-incarceration risk of overdose death. To gain a better understanding of the datasets used for analysis in this report, refer to Appendix B. Additional findings beyond the seven questions from individual datasets can be found in Appendix C. The data linkage process and a summary of how well the linkage plan worked can be found in Appendix D. In Appendix E, the reader can find the approach used to assess data quality and the strategies used to handle missing data. To understand the approach to data privacy followed by this work as well as the system architecture that allows for simultaneous examination of these 10 datasets, the reader is referred to Appendix F. Appendix G briefly summarizes the legal agreements that allowed data partners and other agencies to share data and utilize necessary resources. A full set of cross tabulations of each of the 10 Chapter 55 datasets compared to opioid deaths in 2013 and 2014 is presented in Appendix H. See Appendix I for additional information about Addiction and the Bureau of Substance Abuse Services. Finally, the partners who generously offered their time to make this report possible are listed in Appendix J.

Key Findings from the Across Chapter 55 Datasets

Linking large and complex opioid-related datasets has made it possible to take an unprecedented look at the opioid crisis in Massachusetts. In the section that follows, four analyses are presented that demonstrate the importance of looking across datasets to understand what drives the crisis and what may be done to reduce the rate of death from legal and illegal opioids. In order to support the findings and recommendations, significant technical detail has been added to each of the sections below. This may be more detail than is helpful to some readers, so a summary of the findings and the recommendations has been inserted at the beginning of each section.

Technical Notes: The linked dataset includes males and females in Massachusetts aged 11 and older. All four analyses used this starting population and filter the data according to the hypothesis of specific interest. This report uses standard conventions for naming drugs, drug classes, and chemical compounds. Specific drugs like Heroin and Fentanyl are capitalized. Drug classes and chemical compounds like benzodiazepines and 6-mono acetyl morphine are not capitalized.

Analysis #1 (Toxicology & PDMP): Key Findings and Recommendations

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Analysis #1 - Toxicology & PDMP

Key Findings:
- Individuals who died from opioid-related overdoses are much more likely to have illegally-obtained substances (i.e., not Schedule II-III substances) present in post-mortem toxicology.
- Heroin was present in two-thirds of deaths. Benzodiazepines in over half. Fentanyl and cocaine were each found in roughly one-third.
- Among descendants, 22% had a positive toxicology report for a Schedule II-III opioid, but only 9.1% had a prescription for that drug in PDMP.
- Most toxicology reports had positive tests for more than one substance.

Recommendations:
- Harm reduction strategies and interventions that address Heroin, Fentanyl, and polysubstance use should be increased, expanded, and enhanced.
- Increase in real-time disease surveillance can be used as a public health tool to better understand overdose deaths.
- Data should be reported and collected in a more timely manner, allowing earlier identification of new and emerging trends.

Basic Methods: Toxicology at death was linked with PDMP records among people who died of an opioid-related overdose of unintentional or undetermined intent. Males and females age 11 and above were included. In 2013 and 2014 there were 2,192 Massachusetts residents in our analytic file who died of an opioid-related overdose. Toxicology reports including detailed information regarding specific opioids and other drugs present were available for 77% of these deaths (1,692/2,192). All data below represents these 1,692 people. A breakdown of specific substances present in the toxicology reports was also determined.

Summary of toxicology findings: Overall, 66% of the deaths had Heroin or likely Heroin present. Fentanyl was present in 32% of opioid overdose deaths. More recent data from DPH indicates that Fentanyl presence rose further to 57% in 2015[22]. Heroin or Fentanyl, which is typically sold as Heroin, was present in 85% of the opioid deaths. Schedule II and III prescription opioids were present in 22% of opioid deaths and Oxycodone, the most commonly prescribed opioid, was present in 15% of the opioid deaths. In 9.1% of overdose deaths only, Schedule II and III prescription opioids used only for pain were present, (Heroin, Fentanyl, Methadone, or buprenorphine were not present). Benzodiazepines and Cocaine were present in 58% and 30% of opioid deaths, respectively.

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[22] Accessed at http://www.mass.gov/eohhs/docs/dph/quality/drugcontrol/county-level-pmp/data-brief-overdose-deaths-may-2016.pdf

Categorizing toxicology data: The toxicology tests for Fentanyl, Methadone, buprenorphine, and Cocaine are specific to those particular substances and therefore when they were present it was clear that the decedent had taken those substances prior to death. For this report, individual benzodiazepines were not distinguished on toxicology testing, but reported them as a class. Oxycodone, Hydrocodone, Hydromorphone, Oxymorphone (as a metabolite of Oxycodone or from prescription Oxymorphone), Codeine, and Tramadol are all specific toxicology results for substances where the main source is either prescribed or diverted Schedule II and III prescription opioids intended to treat pain. Therefore, these toxicology results were grouped together as "prescription opioids."

Categorizing Heroin and Morphine presence on toxicology is more complicated. One toxicology result specific for Heroin is 6-monoacetylMorphine (6-mam). However, 6-mam is rapidly metabolized to Morphine and therefore, commonly, is not present on toxicology. When Morphine and Codeine are both present, especially where the quantitative level of Morphine is greater than Codeine, this indicates Heroin use due to impurities retained during Heroin refining from Opium.[23,24] For this analysis, quantitative levels of Morphine and Codeine were not available. The presence of Morphine without Codeine in toxicology occurs due to either 1) prescription Morphine or 2) as a metabolite of Heroin. In order to determine whether to attribute deaths with Morphine present to prescription Morphine or to Heroin, the presence of Morphine prescriptions within the PDMP was reviewed.

Figure KEY1.1: Percent of Deaths (2013-2014) with Specific Drugs Present in Toxicology Results & the Relative Contribution of Prescriptions for the Drugs (2011-2014)

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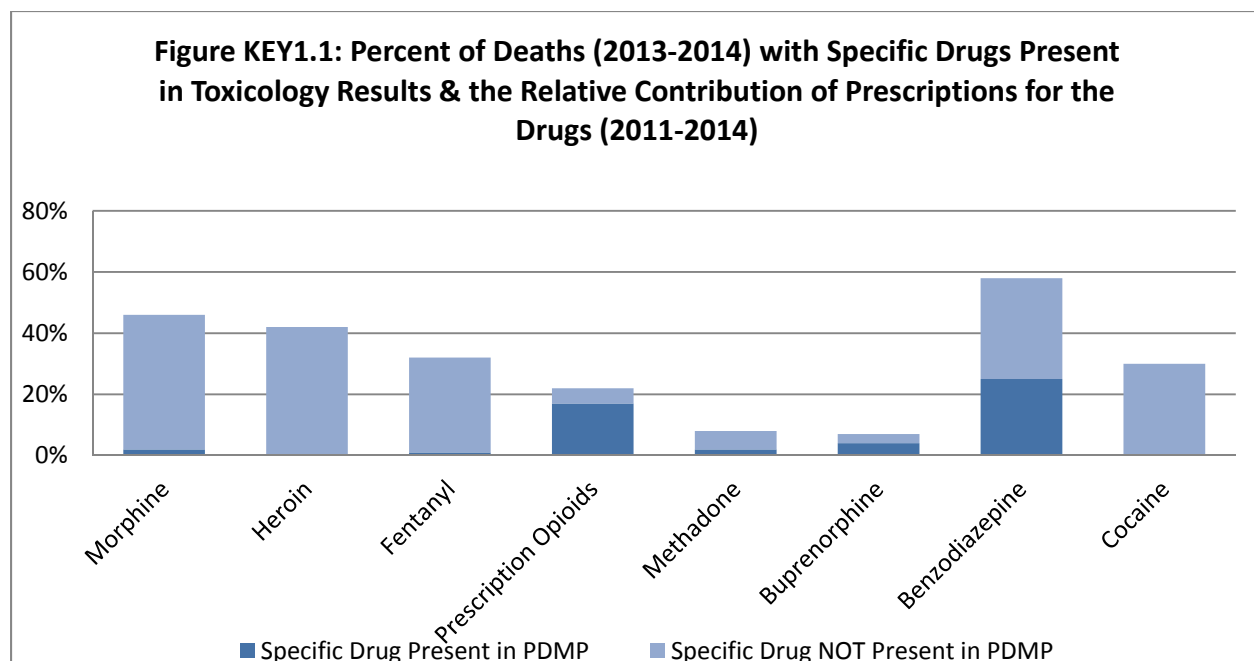
[23] Ceder G and Jones AW. Concentration ratios of Morphine to Codeine in blood of impaired drivers as evidence of Heroin use and not medication with Codeine. Clinical Chemistry. November 2001 vol. 47 no. 11 1980-1984. Accessed at: http://www.clinchem.org/content/47/11/1980.long
[24] Ellis, Ashley D., et al. "Identifying cases of Heroin toxicity where 6-acetylMorphine (6-AM) is not detected by toxicological analyses." *Forensic science, medicine, and pathology* (2016): 1-5.

Notes: Prescription opioids include Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone, Codeine, and Tramadol. Presence in PDMP includes any prescription for the particular drug between 2011 and 2014.

Figures KEY1.1 and KEY1.2 present the proportion of decedents with a specific drug (or Schedule II and III prescription opioid) in their toxicology results and the contribution of opioid prescriptions reported to the PDMP to these proportions. Breaking down the prescription opioid group into its components, substantial fractions of the decedents with Oxycodone, Hydromorphone, Hydrocodone, and Tramadol, present in toxicology had matching prescriptions for those drugs in the PDMP. Almost none had matching prescriptions for Oxymorphone, though this is a metabolite of Oxycodone.

KEY1.2: Percent of Deaths (2013-2014) with Specific Prescription Opioids Present in Toxicology Results & the Relative Contribution of Prescriptions for the Drugs (2011-2014)
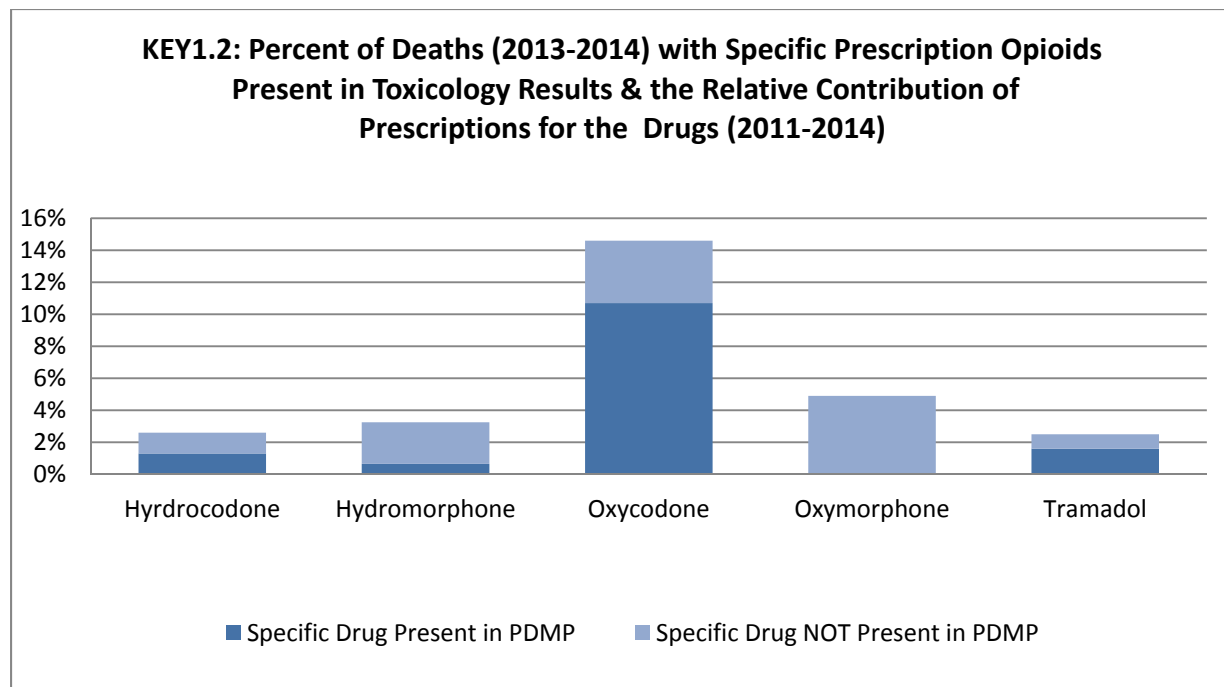
Notes: Presence in PDMP includes any prescription for the particular drug between 2011 and 2014.
Codeine is not included in the chart because <5 prescriptions were filled by this study population.

Based on these results, Morphine toxicology was further categorized as "likely Heroin." When crossed with the PDMP, people who had Morphine present at death had very low rates of Morphine prescription histories. A similar pattern for Fentanyl was observed. For Fentanyl, there is a rapidly expanding distribution of illicitly produced Fentanyl sold as Heroin,[25,26,27] which explains the low rate of Fentanyl prescriptions. In contrast, people with other prescription opioids such as Oxycodone in their
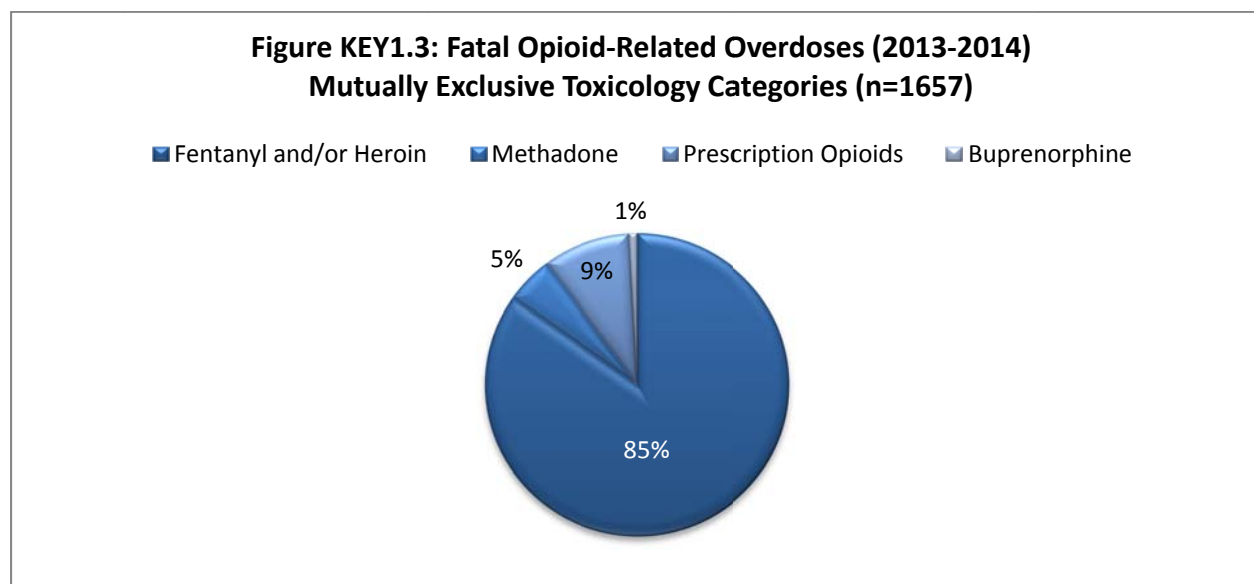
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[25] Rudd, Rose A., et al. "Increases in drug and opioid overdose deaths-United States, 2000-2014." *MMWR: Morbidity and mortality weekly report* 64.50-51 (2016): 1378-1382.
[26] Accessed at: https://www.dea.gov/divisions/hq/2016/hq061016.shtml
[27] Accessed at: http://www.cdc.gov/drugoverdose/opioids/fentanyl.html

toxicology screen, were much more likely to have prescriptions for that opioid. A similar pattern with benzodiazepines and prescription opioids was observed. Morphine is uncommonly prescribed to people who die of overdose, relative to other opioids, yet it is prevalent in toxicology. Thus, most Morphine positive toxicology results are likely due to Heroin. This is supported by the presence of Codeine, but not always. In our linked data, Codeine is present in 48% of definite Heroin screens and Morphine is present >99% of the time. Further examination of the full medical examiner records of these deaths where Morphine is present would be warranted to confirm this assumption.

Opioid-related overdose deaths in mutually exclusive categories were categorized based on decreasing order of deadliness[28] of the specific drugs (*Fentanyl and/or Heroin → Methadone → other Rx → buprenorphine*) present in the results. A person was put into a category based on the deadliest drug present in the results, regardless of the presence of other drugs. For example, if someone had Fentanyl and Methadone present, they would be in the "Fentanyl" group. (See Figure KEY1.3)

Figure KEY1.3: Fatal Opioid-Related Overdoses (2013-2014)
Mutually Exclusive Toxicology Categories (n=1657)

■ Fentanyl and/or Heroin   ■ Methadone   ■ Prescription Opioids   ■ Buprenorphine

1%
5%   9%
85%

Notes: Fentanyl and/or Heroin includes: Fentanyl, Heroin, and Morphine (likely Heroin).
       Prescription opioids include Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone, Codeine, and Tramadol.

Prescription filling by opioid decedents: The timing of Schedule II and III opioid prescriptions and their presence or absence in toxicology screens based on the above mutually exclusive categories of toxicology results demonstrates that decedents, regardless of toxicology at death, were commonly prescribed opioids during the entire study period (2011-2014). The rate of filled prescriptions for

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[28] While "deadliness" is an imprecise term, drugs are considered deadlier when equivalent amounts are more likely to lead to death. In this case, equivalent amounts of Heroin or Fentanyl are more likely to result in death than buprenorphine.

opioids during this period ranged from 60% to 82% depending on the drug. (See Table KEY1.1) Looking only at prescriptions filled within 1 month of overdose death, the rate dropped in each category to a range of 8.4% to 36%. Opioid-involved decedents who died with only prescription opioids on board (representing under ten percent of opioid overdose deaths) were the most likely group to have had a prescription filled in the same month (36%) or in months proximal to their death. (See Table KEY1.1) While the majority of people filled an opioid prescription during the study period, relatively few filled a prescription for an opioid within one month of their death.

Table KEY1.1: Proportion of Decedents (2013-2014) with any Prescription[1] Opioid History (2011-2014) by Category of Opioid Present in Toxicology Screen									
	Overall	Within 1 Month of Death		Within 3 Months of Death		Within 6 Months of Death		Within Study Period	
Toxicology Result	n	n	%	n	%	n	%	n	%
Fentanyl and Definite Heroin Present	166	16	9.6%	22	13.35	38	22.9%	104	62.7%
Fentanyl and Likely Heroin Present	83	7	8.4%	16	19.3%	21	25.3%	54	65.1%
Fentanyl Present	288	50	17.4%	64	22.2%	87	30.2%	195	67.7%
Definite Heroin Present	547	71	13.0%	104	19.0%	150	27.4%	353	64.5%
Likely Heroin Present	320	39	12.2&	68	21.3%	92	28.8%	207	64.7%
Methadone Present	84	23	27.4%	34	40.5%	39	46.4%	64	76.2%
Prescription Opioid Present	154	57	37.0%	77	50.0%	88	57.1%	127	82.5%
Buprenorphine	15	<5	N/A	<5	N/A	<5	N/A	9	60.0%
Total	1657[29]	--[2]	--[2]	--[2]	--[2]	--[2]	--[2]	1113	67.2%

1. Includes any prescription for Fentanyl, Methadone, Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone, Morphine, or Codeine
2. Number not displayed because of complimentary suppression rules.

Polysubstance use: Polysubstance use can involve using 2 drugs for non-medical purposes. For example, benzodiazepines[30] are commonly taken with opioids for non-medical purposes. The combination of the medications depresses the central nervous system at a higher rate than just using one of the medications. Benzodiazepines are commonly taken with opioids for non-medical purposes. Benzodiazepines are present consistently in toxicology screens, regardless of the opioid present, in over half of overdoses. This pattern has been demonstrated in other populations.[31] The proportion of people with a prescription for a benzodiazepine within one month of death ranged from 14-25% in the toxicology subgroups while over half had a prescription during the study period. (See Table KEY1.2) Of particular note, benzodiazepines were present in 62% of overdoses when only a prescription opioid was

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[29] This value (1,657) differs from the total number of cases with toxicology reports (1,692) because there were 35 cases in which no positive results for the substances listed in the table were detected.

[30] This medication is in the sedative/hypnotic drug class, and acts on the central nervous system. When used in combination with an Opioid, it poses a very high risk for overdose.

[31] Park, T. W., Saitz, R., Ganoczy, D., Ilgen, M. A., & Bohnert, A. S. (2015). Benzodiazepine prescribing patterns and deaths from drug overdose among US veterans receiving opioid analgesics: case-cohort study. B*mj*, *350*, h2698.

present, and 25% of these had a prescription within a month of their death. They were present 69% of the time when Methadone was present, and 24% of these people had a prescription for a benzodiazepine within a month of death. (See Table KEY1.3)

Unlike the specific opioid products, benzodiazepines had a presence in death toxicology samples that exceeded the prevalence prescribed. While benzodiazepines were present in 982 toxicology screens, only 495 people ever had a prescription for one and less than 200 had a prescription within one month of their death. This suggests a substantial amount of diversion, and that benzodiazepines involved in opioid overdose deaths are a combination of prescribed and diverted pills. (See Table KEY1.3)

Another drug commonly seen in opioid deaths was Cocaine. Overall, 30% of opioid decedents with a toxicology screen also had Cocaine present in their system.   When Fentanyl, Heroin, or buprenorphine is present, Cocaine is present about 1/3 of the time. Cocaine is less commonly present when Methadone (21%) or prescription opioids (13%) are present.

Table KEY1.2: Proportion of Decedents (2013-2014) with a Prescription Benzodiazepine History (2011-2014) by Category of Opioid Present in Toxicology Screen									
	Over all	Within 1 Month of Death		Within 3 Months of Death		Within 6 Months of Death		Within Study Period	
	n	n	%	n	%	n	%	n	%
Fentanyl and Definite Heroin Present	166	14	14.7%	21	22.1%	21	22.1%	47	49.5%
Fentanyl and Likely Heroin Present	83	6	13.6%	6	13.6%	7	15.9%	14	31.8%
Fentanyl Present	288	31	18.0%	38	22.1	44	25.6%	78	45.4%
Definite Heroin Present	547	54	17.9%	75	24.9	93	30.9%	146	48.5%
Likely Heroin Present	320	40	22.0%	54	29.7	63	34.6%	94	51.7%
Methadone Present	84	14	24.1%	19	32.8%	25	43.1%	40	69.0%
RX Present	154	24	25.3%	34	35.8%	39	41.1%	60	63.2%
Buprenorphine	15	<5	N/A	<5	N/A	<5	N/A	8	57.1%
Total	1657	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	50.4%

1. Number not displayed because of complimentary suppression rules.

Table KEY1.3: Proportion of Decedents with Benzodiazepine or Cocaine Present in Toxicology Screen by Category of Opioid Present in Toxicology Screen (2013-2014)				
	Frequency	% of Total	% with Benzodiazepine	% with Cocaine
Fentanyl and Definite Heroin Present	166	10.0%	57.2%	31.3%
Fentanyl and Likely Heroin Present	83	5.0%	53.0%	33.7%
Fentanyl Present	288	17.4%	59.7%	32.6%
Definite Heroin Present	547	33.0%	55.0%	30.7%
Likely Heroin Present	320	19.3%	56.9%	32.2%
Methadone Present	84	5.1%	69.1%	21.4%
RX Present	154	9.3%	61.7%	13.0%
BPN Present	15	0.9%	93.3%	33.3%

Limitations: The Chapter 55 project has facilitated the linkage of death, toxicology, and PDMP data at the individual level, which has allowed us to obtain a clearer picture of what opioids and other substances are present and how often opioids and benzodiazepines are prescribed. However, there are several limitations to our analyses at this point. First, the overdose death data are limited to 2013 and 2014 and therefore little can be said about time trends with two years of data. Expanding this analysis to more years would allow for analysis and surveillance of changes over time. The rapidly rising rates of Fentanyl present at overdose deaths from 2013 to 2015 is one example of why real-time surveillance of overdose death toxicology is an important public health tool. For the toxicology dataset, as discussed above, it is not clear how to attribute deaths where Morphine is present on toxicology. Based on a review of the PDMP data, it was decided to define these as "likely Heroin" present. A more in-depth review of the subset of deaths with this toxicology result is warranted to confirm or further inform our assumptions. The toxicology also does not include routine testing for substances like Gabapentin, Promethazine or Clonidine, which may be diverted and used in combination with opioids.[32,33,34,35,36] Further, the toxicology testing is not sensitive for alcohol, which is an established contributor to polysubstance overdose death. Therefore the role that these substances may be playing in opioid-related overdose deaths cannot be determined. The PDMP dataset includes methadone prescribed for pain management, but does not include Methadone dispensed through opioid treatment programs. In this analysis, the data was not available to link toxicology to Methadone treatment data from the Bureau of Substance Abuse Services, which would help address this limitation.

[32] Smith, RV, et al. "Gabapentin misuse, abuse and diversion: a systematic review." Addiction. 2016 Jul;111(7):1160-1174. doi: 10.1111/add.13324. Epub 2016 Mar 18.

[33] Shapiro, B. J., Lynch, K. L., Toochinda, T., Lutnick, A., Cheng, H. Y., & Kral, A. H. (2013). Promethazine misuse among methadone maintenance patients and community-based injection drug users. Journal of addiction medicine,7(2), 96.

[34] Lynch, K. L., Shapiro, B. J., Coffa, D., Novak, S. P., & Kral, A. H. (2015). Promethazine use among chronic pain patients. Drug and alcohol dependence, 150, 92-97.

[35] Dennison, S. J. (2001). Clonidine abuse among opiate addicts. Psychiatric quarterly, 72(2), 191-195.

[36] Beuger, M., Tommasello, A., Schwartz, R., & Clinton, M. (1998). Clonidine use and abuse among methadone program applicants and patients. Journal of substance abuse treatment, 15(6), 589-593.

Implications and recommendations based on Key Finding #1:

- Heroin and/or Fentanyl, and benzodiazepines are present at the majority of opioid overdose deaths and thus are likely to be driving the increases in overdose.
- Increased real-time surveillance capacity that integrates linkable data from multiple sources is crucial to understanding the rapidly increasing overdose death rates.
- Harm reduction strategies and interventions that address Heroin, Fentanyl, and polysubstance use (especially benzodiazepines and Cocaine) should be increased, expanded, and enhanced.
- More outreach and education regarding use of the online PDMP to detect patients receiving multiple drugs is essential to improve coordination of care and thus reduce overdose risk.
- People who die from opioid-related overdose are commonly prescribed opioids, though less commonly at the time close to their death. Therefore, the role of prescription opioids in overdose death is more likely part of the development of upstream risk, than a downstream proximal cause. Interventions focused on reducing access to prescription opioids should be paired with interventions that address Heroin, Fentanyl, and polysubstance use as the proximal causes of overdose.

Analysis #2 (Nonfatal Overdoses and Opioid Agonist Treatment): Key Findings and Recommendations

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Analysis #2 - Non Fatal Overdoses and Opioid Agonist Treatment (OAT)

<u>Findings</u>
- Following nonfatal overdoses, individuals receiving opioid agonist treatment (i.e., medications such as methadone & buprenorphine that block the effect of opioids) were significantly less likely to die from a subsequent opioid overdose. (Note: Data on naltrexone/Vivitrol use comes from the APCD. Analyses are ongoing.)
- Despite previous history of nonfatal overdoses, engagement in opioid agonist treatment (OAT) remained constant (~5%) over a 12-month follow-up period, indicating lost opportunities to save lives.

<u>Recommendations</u>
- Strategies for making MATs for opioid use disorders more accessible to individuals who experience a nonfatal opioid overdose should be prioritized.
- Follow-up period of analysis should be extended to determine whether protective factor of OAT persists beyond 12 months.

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Basic Methods: Treatment patterns and outcomes following nonfatal opioid-related overdose were examined. Males and females age 11 and above were included in the analysis. By linking data from MATRIS and the death index at the individual level, 7,634 individuals were identified who survived an ambulance encounter for an opioid-related overdose in Massachusetts between 2013 and 2014.

Summary of Findings: Over a median follow-up period of 10 months, 149 individuals (2.0%) with non-fatal overdose experienced a subsequent fatal opioid-related overdose. Analyzed another way, at least 6.8% (149 of 2,192) of total opioid-related overdose deaths in Massachusetts over the relevant period were preceded by a nonfatal opioid-related overdose as detected in MATRIS. Since not all opioid-related overdoses are captured by MATRIS, these values are almost certainly underestimates.

For those individuals who experienced a nonfatal opioid overdose, engagement in opioid agonist treatment (OAT) in the period surrounding the nonfatal opioid overdose was examined. Specifically, monthly exposure to OAT was studied using BSAS records for treatment with Methadone or buprenorphine or PDMP dispensing for buprenorphine. During the month of the nonfatal opioid-related overdose, 4.7% of individuals were engaged in OAT. Engagement in OAT remained relatively constant over 12 months of follow-up, with 5.2% of individuals receiving OAT in month 12 (Figure KEY2.1).

Figure KEY2.1: Engagement in Opioid Agonist Treatment by Month Following a Nonfatal Opioid-Related Overdose (2013-2014).
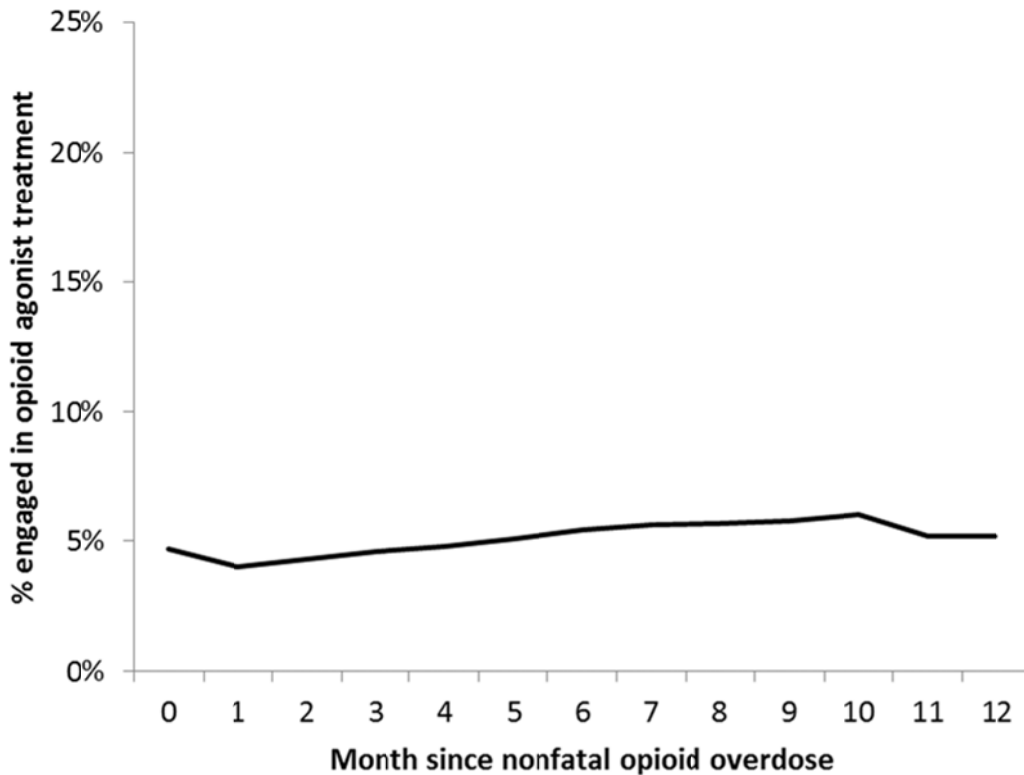
Finally, time to fatal opioid-related overdose was examined. All deaths due to other causes through the end of the study period (December 2014) were removed from the analysis. Here, the cumulative incidence of fatal opioid-related overdose stratified by exposure to OAT using an extended Kaplan-Meier estimator, treating OAT exposure as a time varying covariate defined as exposed in the month of or month prior to the month at risk for opioid-related death was calculated. The cumulative incidence of fatal opioid-related overdose was 1.1% for those engaged in OAT versus 2.3% for those not engaged in OAT. Thus, among people who have a nonfatal opioid-related overdose, those who are engaged in OAT had a risk of subsequent fatal opioid-related overdose that is less half of those who are not engaged in OAT.

Limitations: There are several potential limitations of this preliminary analysis. First, these estimates likely represent a substantial underestimate of the number of nonfatal opioid-related overdoses in Massachusetts. Not all nonfatal opioid-related overdose events result in an ambulance encounter, and not all ambulance encounters are captured in MATRIS. To build on this analysis, nonfatal opioid-related overdoses identified in the emergency room and inpatient settings from the Case Mix will be included datasets once these data are available. Second, the findings related to the impact of OAT are observational and likely subject to substantial confounding. Additional analyses will be conducted to adjust for factors that may influence treatment decisions as well as fatal opioid-related

overdose. As part of this, geospatial variability will be explored to compare the intersection of where individuals experience nonfatal opioid overdose and where they access treatment that may inform hotspots that should be targeted with additional resources. Finally, a range of treatment options beyond OAT will be examined including opioid antagonist treatment (e.g. injectable extended-release Naltrexone) and detoxification admissions.

Implications and recommendations based on Key Finding #2

- A substantial portion of opioid-related overdose deaths in Massachusetts are preceded by a nonfatal opioid overdose.
- Engagement in OAT following nonfatal opioid-related overdose was found to be associated with a substantial decrease in the risk of a subsequent fatal opioid-related overdose. Despite this risk reduction (50% less risk of an overdose by those engaged in OAT versus those who did not engage in OAT), the proportion of people who engage in OAT following a nonfatal opioid overdose remains low.
- Presentation to the health care system with nonfatal opioid-related overdose represents an opportunity to engage high-risk individuals in treatment.
- There is substantial opportunity to develop novel public health approaches to identify individuals who experience nonfatal opioid-related overdose and engage them in treatment.

Analysis #3 (Gender Differences and the PDMP): Key Findings and Recommendations

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Analysis #3 - Gender Differences and the PDMP

Key Findings
- Between 2011 and 2014, women filled nearly one million more Schedule II and III opioid prescriptions than men.
- Women are significantly more likely than men to receive Schedule II and III opioids from 3 or more prescribers and obtain them from 3 or more pharmacies.
- Obtaining Schedule II and III opioid prescriptions from multiple prescribers and filling them at multiple pharmacies are significant risk factors for subsequent opioid-related death.

Recommendations
- Alerts in MassPAT should be configured to assure that prescribers and pharmacists are aware of potential patient misuse and diversion of Schedule II-III opioids.
- Prescribers and pharmacists should be educated about personal biases associated with "expected" risks for certain populations.
- Providers should consider gender differences when screening, assessing, diagnosing and treating patients.

</div>

Basic Methods: Demographic differences in general and gender differences in specific were examined in outcomes related to opioid-related overdose deaths and risk factors for these deaths. Males and females age 11 and above were included in the analysis. Toxicology and PDMP data were linked to deaths. Demographics were used from all available sources. Bivariate analyses using the Chi Squares were performed in order to determine if there were any significant differences in frequencies between gender and age groups.

Summary of Findings: There are differences between the substances found in the toxicology screening of males and females who die as a result of an opioid-related overdose. While males were statistically significantly more likely to have Heroin present in their toxicology screen as compared to females who died during the study period ($\rho \leq 0.001$), females were statistically significantly more likely than males to have a prescription opioid in their toxicology screening ($\rho \leq 0.001$). Overall, in the PDMP database, females were more likely than males to have 3 or more prescribers (p<.0001). Females who died of an opioid overdose were more likely than males to have 3 or more prescribers (p<.0001) and to fill prescriptions at multiple pharmacies (p<.0001). For frequencies see Tables KEY3.1 and KEY3.2.

Toxicology Results and Gender: In 2013-2014, there were 1,692 opioid-related decedents where data was available for the toxicology screen. These decedents are represented in the tables below; 485 decedents were female and 1,207 were male. Table KEY3.1 displays the presence of a prescription opioid in the toxicology screen by gender. The key finding is that 27.8% of females had a prescription opioid present in their toxicology screen while only 18.5% of males did. Further analyses

indicated that this result was statistically significant. While fatal opioid overdoses occur most frequently in males, this data suggests that women are disproportionately impacted by prescription opioids. As described in other sections of this report, the presence of Morphine in a toxicology screen is due to prescription Morphine or Heroin metabolites. Decedents were categorized as deaths that were likely attributable to Heroin when there was no matching Morphine prescription documented in the PDMP database.

Table KEY3.1: Presence of a Prescription Opioid in Toxicology Screen by Gender (2013-2014)						
	Males			Females		
Toxicology Results	N	% of total	% of Males	N	% of total	% of Females
Prescription Opioid Present	223	13.2%	18.5%	135	8.0%	27.8%
No prescription opioid present	984	58.2%	81.5%	350	20.7%	72.2%

Table KEY3.2 displays the presence of Heroin in the toxicology screen by gender. The key finding is that 68.9% of males had Heroin present in their toxicology screen while only 58.6% of females did. Additional analysis demonstrated that males were statistically significantly more likely than females to have Heroin present.

Table KEY3.2: Presence of Heroin in Toxicology Screen by Gender (2013-2014)						
	Males			Females		
Toxicology Results	N	% of total	% of Males	N	% of total	% of Females
Heroin Present	832	49.2%	68.9%	284	16.8%	58.6%
No Heroin present	375	22.2%	31.1%	201	11.9%	41.4%

When differences in toxicology screening findings based upon gender are further divided into age categories – younger than 18 years, 18-44 years, 45-64 years and 65 years and older, the differences observed largely remain. Table KEY3.3 and Table KEY3.4 display the presence of Heroin and prescription opioids, respectively by gender and age group. In the first three age categories – younger than 18 years, 18-44 years and 45-64 years – males are statistically significantly more likely to have Heroin in their toxicology screens as compared to females. In the age category 45-64 years, females are statistically significantly more likely to have prescription opioids in their toxicology screens as compared to males. Only the oldest group, 65 years and older, did not observe a difference between males and females.

The size of this last group was small relative to the other three groups; there were only 25 decedents in this oldest group.

Table KEY3.3: Presence of Heroin in Toxicology Screen by Sex and Age Group (2013-2014)					
		Younger than 18 Years	18-44 Years	45-64 Years	65 Years+
Heroin Present	Male	76	497	256	<5
	Female	35	156	91	<5
Heroin Not Present	Male	70	350	273	12
	Female	14	166	176	18

Table KEY3.4: Presence of Prescription Opioid in Toxicology Screen by Sex and Age Group (2013-2014)					
		Younger than 18 Years	18-44 Years	45-64 Years	65 Years+
Prescription Opioid Present	Male	14	95	108	6
	Female	7	45	73	10
Prescription Opioid Not Present	Male	97	587	295	5
	Female	36	194	116	<5

Prescribing Patterns and Gender: Figures KEY3.1 and KEY3.2 show the breakdown of number of prescribers by the gender of the decedent. 35% of males who died of an opioid overdose had three or more prescribers of a scheduled drug, as compared with 61% of females.
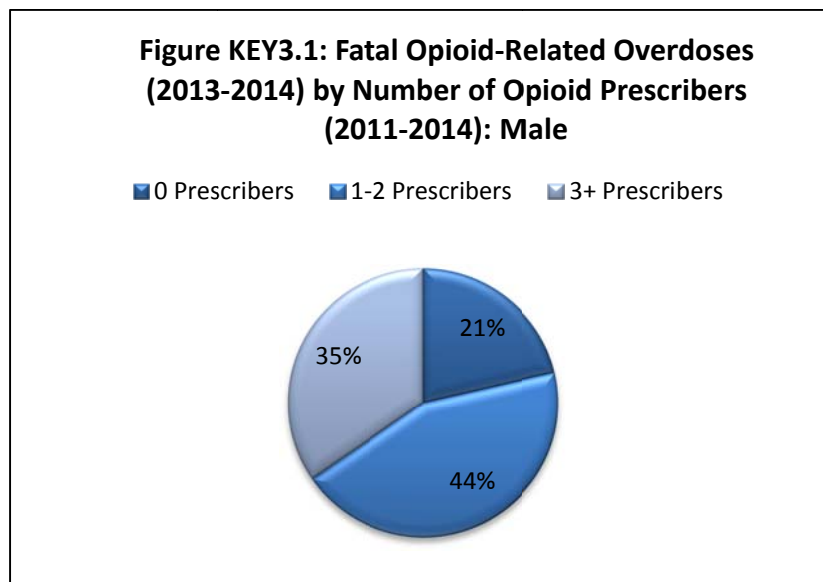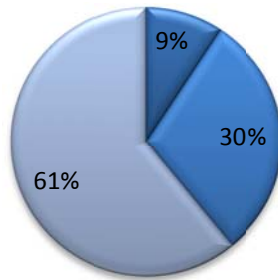

Figure KEY3.1: Fatal Opioid-Related Overdoses (2013-2014) by Number of Opioid Prescribers (2011-2014): Male

■ 0 Prescribers   ■ 1-2 Prescribers   ■ 3+ Prescribers

21%
35%
44%

Figure KEY3.2: Fatal Opioid-Related Overdoses (2013-2014) by Number of Opioid Prescribers (2011-2014): Female

■ 0 Prescribers   ■ 1-2 Prescribers   ■ 3+ Prescribers

9%

30%

61%

In the linked data, there were 1,206 males and 597 females who died of an opioid-related overdose and had at least one opioid prescription in the PDMP. In this group, females were more than three times as likely to have 3 or more prescribers of a scheduled drug as compared with 1-2 prescribers as males. They were also almost three times as likely to fill scheduled drug prescriptions at three or more pharmacies as males.

Limitations: There are several limitations of these analyses that should be cited. First, only about three quarters of the opioid related deaths had drug specific toxicology screens available and so it is not possible to comment on the possible drugs present in the remaining population. Second, as stated previously, the presence of Heroin is derived from the absence of a Morphine prescription in the PDMP database and the presence of a Heroin metabolite in the toxicology screen. Although very few providers prescribe Morphine to their patients, it is possible that there are Morphine prescriptions that were not entered into the PDMP database and so these decedents may represent a false negative. Third, this analysis does not include claims data from the Case Mix Database or APCD. Integrating this information in future analyses can help to identify variables associated with the differences observed between sexes.

Implications and recommendations based on Analysis #3:

- Individual providers should take the observed gender differences into consideration when screening, assessing, diagnosing, and treating patients. Providers should utilize the PDMP database to identify any active or past prescriptions for their patients, particularly females, and to provide coordinated care.

- Addiction Services and Treatment providers must incorporate the observed differences in toxicology screens by gender into the planning, development, and implementation of recovery services.
- Finally, policymakers should consider Addiction Services public service campaigns that integrate the gender-based differences observed into the messaging and advocate for additional in-depth analyses towards better understanding the gender-based differences.

Analysis #4 (Post Incarceration Risk): Key Findings and Recommendations

Analysis #4 – Post Incarceration Risk

Key Findings
- The risk of opioid-related overdose death following incarceration in Massachusetts is over 50 times higher than for the general public.
- The risk of death is highest in the month following release.
- Among those released from prison, young people aged 18 to 24 have roughly 10 times the risk of death upon release compared to individuals 45 years and older.

Recommendations
- Ensuring the availability of treatment within correctional facilities, and improved aftercare planning for inmates prior to release has the potential for life-saving impact and should be prioritized.
- Treatment and overdose prevention services should be expanded in correctional facilities and should be standardized, evidence-based, and monitored.
- Further research is warranted to identify other specific risk factors associated with the increased risk for those released from incarceration.

Basic Methods: Previous studies in the United States as well as in other countries have identified a markedly increased risk of death in former inmates, compared with the general population, particularly in the first month following release[37,38]. This excess mortality is predominantly due to an increased risk of injury death, often due to drug-related causes[39]. In order to calculate Crude Mortality Rates (CMR), person-years were calculated to account for the amount of time at risk for death for former inmates. Person-years were defined as the total number of days in the study period during which former inmates were not incarcerated during 2013-2014, including days between each release and the subsequent incarceration, the end of the study period, or death. For the rest of the Massachusetts population, the Massachusetts population counts from the 2013-2014 Modified Age, Race/Ethnicity, and Sex files (MARS) were used, which are a bridged population file produced by the National Center for Health Statistics (NCHS) and the Census Bureau Population Estimates Program and subtracted the total person-years of formerly incarcerated people. In addition, mortality rates were calculated by dividing the number of deaths by the number of person-years. To calculate the number of deaths among non-incarcerated Massachusetts residents, the total number of deaths among formerly

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[37] Kariminia A, Butler TG, Corben SP, Levy MH, Grant L, Kaldor JM, Law MG: Extreme cause specific mortality in a cohort of adult prisoners – 1998 to 2002: a data-linkage study. Int J Epidemiol. 2007, 36 (2): 310-8.10.1093/ije/dyl225.

[38] Glaze L. E., Keuble D. Correctional Populations in the United States, 2013. Washington, DC: Bureau of Justice Statistics; 2014.

[39] Merrall EL, Kariminia A, Binswanger IA, Hobbs MS, Farrell M, Marsden J, Hutchinson SJ, Bird SM: Meta-analysis of drug-related deaths soon after release from prison. Addiction. 2010, 105 (9): 1545-1554. 10.1111/j.1360-0443.2010.02990.x

incarcerated people was subtracted from the total number of deaths among Massachusetts residents within each age category **for persons aged 18 to 64 years**. Finally, a multivariate analysis to examine risk factors associated with overall mortality and opioid-related mortality was conducted.

Summary of Findings: 13,918 former inmates released between 2013 and 2014 were identified. These individuals spent 5,707 person-years in the community after release, 287 died from all causes, and 121 consequently died from an opioid-related overdose during the study period. Rate of opioid-related overdose was approximately 50 times higher in formerly incarcerated people than in non-incarcerated Massachusetts residents. Former inmates also had a significantly lower overall survival than non-inmates (p<0.0001).

Table KEY4.1: Deaths and years at risk by time, since being released from a state Correctional facility (2013-2014)			
	Opioid Deaths	**Population**	**Rate per 100000**
Former Inmates	121	13,918	869.4
Everyone else (non-former inmates)	2,071	13,423,695[40]	15.4
Rate Ratio			**56.4**

Our findings also suggest that there is a significantly elevated mortality risk in the earliest time-periods after being released from a state correctional facility, when compared with other non-critical time periods. The largest proportions of former inmates died within the first month (Figure KEY4.1).

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[40] This figure represents sum of the population of the state in 2013 and 2014.

Figure KEY4.1: Opioid Deaths by person-years, inmates since being released from a state Correctional facility (2013-2014)
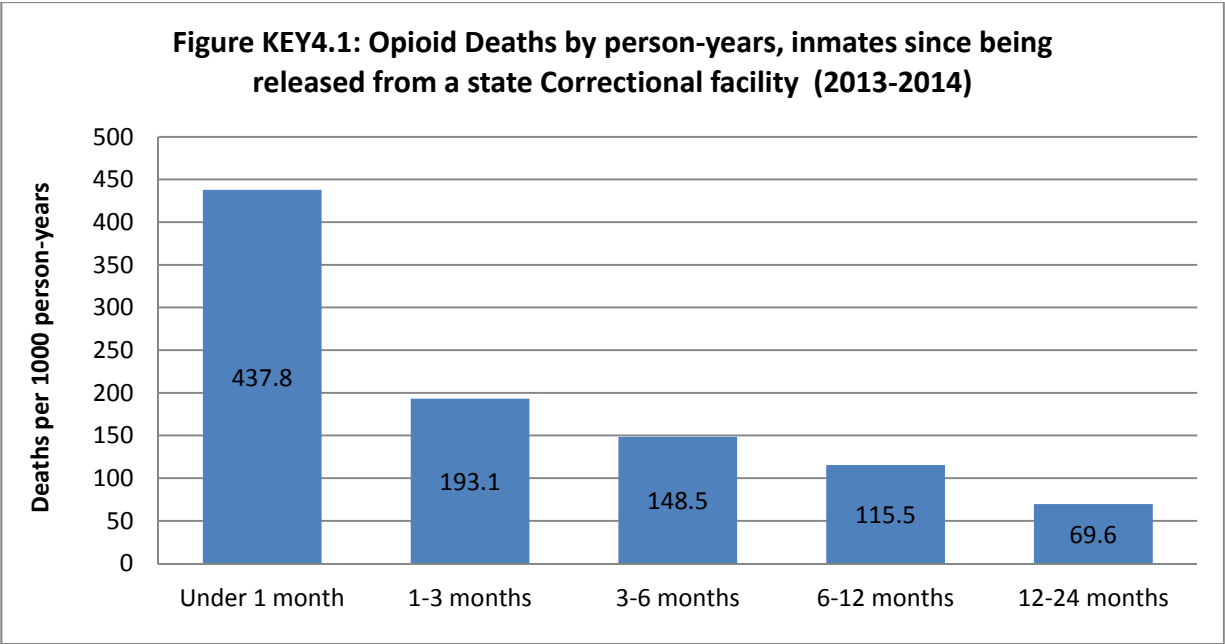
The first month after release proved to be a critical time period for former inmates, having rates that were between 2 to 6 times higher than for later times for all-cause mortality (Table KEY4.2). Likewise, when examining opioid-related overdoses, former inmates had death rates in the 1st month after release that were up to 6times higher than rates at later times.

Table KEY4.2: Overall and Opioid Deaths by person-years, inmates since being released from a state Correctional facility (2013-2014)				
Time Periods	Overall Deaths		Opioid-related deaths	
	Number of deaths	CMR per 100 person-years	Number of deaths	CMR per 100 person-years
Under 1 month	86	573.4	31	437.8
1-3 months	42	218.4	18	193.1
3-6 months	59	160.3	33	148.5
6-12 months	63	116.9	26	115.5
12-24 months	37	75.6	13	69.6

A logistic regression was also conducted on all deaths and opioid-related deaths and the following variables were included in the model: age at death or at December 2014, gender, race, and 2 variables to describe the periods of incarceration: the cumulative number of days spent in jail (≤1 month vs. >1 month) and the frequency of incarceration. Although, not a high R^2 (20%), it is worth highlighting that age was a significant predictor. The youngest at the time of release were most at risk: former inmates 18-24 years of age were almost 10 times more likely to die from an opioid-related overdose than any those that were 45 years and older. Likewise, former inmates that were 25-35 and 35-44 years

of age were 4 times more likely to die from an opioid-related overdose than any those that were 45 years and older.

Table KEY4.3: Odds Ratios for Opioid Overdoses (2013-2014)			
Effect	Point Estimate	95% Confidence Limits	
Male vs. Female	0.8	0.5	1.4
18-24 vs. 45+	9.4	3.0	29.5
25-35 vs. 45+ years	3.9	2.0	7.6
35-44 vs. 45+ years	3.5	1.6	7.6
White non-Hispanics vs. All others	1.7	0.3	8.8
2 vs. 1 incarceration	0.8	0.4	1.5
3+ vs. 1 incarceration	1.0	0.3	3.0
More than 1 month vs. Under 1 month in prison	1.4	0.8	1.4

Limitations: There are some limitations associated with using DoC data to better understand the intersection of Opioid overdoses and criminal justice involvement in the Commonwealth. Even though there is a large overlap between those that are criminally involved and those that have a SUD, there is a large assumption in this analysis - not everyone who is incarcerated is in need of substance abuse treatment.

The treatment indicator within the DoC data does not specify the type of treatment an individual received, and it may in fact include self-help groups. The indicator also does not specify the date when the treatment was received; therefore, it is hard to determine for those that had a lengthy sentence, whether the treatment was received closer to the beginning or end of a sentence, which may impact the overdose outcome.

DoC data includes incarcerations for those in prison and does not include data for people in jails or houses of correction (HoC). The data from DoC used in this analyses (e.g. those incarcerated during the study period and released) is only a subset of the individuals incarcerated within Massachusetts during this study period. This analysis does not included individuals that were not released during the study period, and it does not include individuals incarcerated within Hoc. HoC servers a higher volume of inmates per year in comparison to DoC, primarily due to shorter sentences and those waiting trial within Hoc. Due to this limitation, using DOC data to understand the intersection between fatal opioid

overdoses and the criminal justice system in Massachusetts does not provide a full picture to determine associated risks. An additional limitation arises if residents of Massachusetts are incarcerated outside of Massachusetts as that data is not captured by the DoC.

Implications and recommendations based on Analysis #4:

- Of the 25,209 inmates released 13,918 were released during 2013 and 2014. Of these, 287 died during the same time period. In this group, 42.2% (n=121) died from an opioid-related overdose. In comparison, for the total population in the state, opioid-related deaths accounted for only 2.1% (n=2,192) of deaths.

- Opioid-related overdose deaths in former inmates accounted for 5.5% of all opioid-related deaths in the time period. Former inmates who died from opioid-related overdoses were on average younger, more likely to have a High School education or less, and less likely to be married at or around the time of death, compared with those who died from all other reportable causes.

- These findings corroborate previous studies indicating that recently released prisoners are at increased risk for death following their release, particularly in the early period and particularly younger released prisoners.

- Ensuring treatment behind the walls and aftercare planning for released prisoners could potentially have a large public health impact.

- Increase education for overdose prevention (e.g. abstinence while incarcerated and relapsing upon release poses a risk for overdose.

- Further research is also warranted to identify other specific risk factors associated with this increased risk.

Conclusions

The rate of opioid-related deaths in Massachusetts has increased sharply in recent years. Some communities have been very hard hit by this public health crisis, but all communities have felt the burden of deaths, nonfatal overdoses, job loss, poor health, disintegrated family structures, or disrupted neighborhoods. Important findings described in this report include the fact that illicit drugs, not prescription drugs, are much more commonly present in post-mortem toxicology. As a result, increasing the availability of interventions that address Heroin, Fentanyl, and polysubstance use (especially benzodiazepines and Cocaine) could significantly reduce the opioid-related death rate. Also, opioid agonist treatment (OAT) like methadone or buprenorphine was found to be associated with a significantly lower risk of fatal opioid overdose following a previous nonfatal opioid overdose. A comprehensive plan for delivering OAT could significantly lower the death rate. This study also determined that women are more likely than men to obtain prescription opioids and to have prescription opioids present in post-mortem toxicology. While legal and illegal opioids pose a risk for men and women alike, prescribers should be educated to utilize the PDMP database to identify any active or past prescriptions for their patients, particularly females, and to provide coordinated care. To further reduce the opioid-related death rate, particular focus could be paid to the population of individuals being released from Massachusetts prisons. Their short-term risk of death from opioid-related overdose is 56 times higher than for the general public. Given the high risk of death in this population, better care coordination should also reduce the number of deaths.

The Chapter 55 legislation permitted the development and examination of a first ever cross-sector, linked dataset related to opioid deaths. The insights highlighted in this report would not have been possible without the capacity to create a confidential and secure dataset which was developed under the authority of Chapter 55. This approach also holds promise for other critical public health concerns. The unique partnership forged between government, academia, and industry to address a critical public health problem could form the roadmap for conducting complex analytic work in the future.

Appendix A: The Seven Chapter 55 Statutory Questions

This section presents the original statutory language of each question, restates it as a specific question, discusses its significance, presents results, and discusses findings. The analytic restatement is seen as an opportunity for the researchers to confirm they understand the underlying intent motivating the questions as presented in the legislation.

Note: For privacy purposes, the data sets used for Chapter 55 analyses record information in the month of occurrence. No exact dates are used. In most cases, the presence or absence of <u>any</u> event was recorded in the month <u>not the count</u> of those events. Therefore, statements made about these data cannot directly be interpreted as averages but instead as the average number of months that any type of event occurred.

<u>**Statutory Question 1:**</u> *"Instances of multiple provider episodes, meaning a single patient having access to opiate prescriptions from more than 1 provider"*

Analytic Question 1: *"Does having multiple prescribers increase a patient's risk of fatal opioid-related overdose?"*

Individuals who obtain prescriptions for opioids from more than one prescriber may be at greater risk of death. Receiving prescription opioids from multiple prescribers with the intent of deceiving the prescriber about the volume of opioids received is often referred to as "doctor shopping." While there is general acceptance that this is a risk factor for death, it is actually unknown how many persons in Massachusetts have died of an opioid-related overdose who also obtained prescriptions from more than one health care provider. This analysis provides an opportunity to examine the assumption that persons going to multiple providers for opioid prescriptions are at increased risk of death from opioid-related overdose. To answer this question, the Prescription Drug Monitoring Program (PDMP) dataset was linked to death certificates where the causes of death were noted. The linked dataset was analyzed for opioid prescriptions by patient, their demographics (age, gender, race, marital status, employment, and geography), the number of prescribers, and the outcome (opioid-related death, any death, or still living- no death). The analysis was conducted to determine the relationship between the number of prescribers and likelihood of dying of an opioid-related overdose.

Table A1: Relative Risk of Opioid-Related Overdose (2013-2014) by Number of Prescribers in a Three Month Period (2011-2014)			
Number of Prescribers vs. Risk of Fatal Opioid-Related Overdose	1 – 2 Prescribers	3+ Prescribers	Relative Risk Ratio
Total Fatal Overdoses	648	808	
Total Individuals with at least 1 opioid prescription	~2.1M	~400,000	
Incidence	~1.5 per 10,000 per year	~10.1 per 10,000 per year	~7
Summary	Based on observed data, the use of 3 or more prescribers associated		

	with a 7-fold increase in risk of fatal opioid-related overdose

Discussion: Having three or more prescribers does not necessarily or automatically imply the patient is exhibiting the behavior colloquially known as "doctor shopping." There are notable exceptions, such as multi-provider practices in which prescriptions could be written for a single patient by multiple providers as part of normal operations. Having said that, there is still a clear pattern supported by the data that once three or more prescribers write prescriptions for opioids in a three-month window there is a marked increase in the likelihood of an opioid-related overdose. It should be noted that the three-month period that defined a multi-prescriber event did not have to occur within any specific amount of time prior to death. The relationship examined was whether any multi-prescriber event (i.e., 3 or more prescribers) was associated with an increased risk of death of an opioid-related overdose.

Limitations: The identifiers in the PDMP data set are imperfect. As such, it is highly likely that the multi-prescribers events are underestimated. That said, there is no reason seen in these data to suggest that these undetected cases would substantially alter the conclusions drawn here. If anything, individuals using multiple forms of identification might logically be assumed to be at higher risk than those not attempting to avoid detection.

Statutory Question 2: *"Instances of poly-substance access, meaning a patient having simultaneous prescriptions for an opiate and a benzodiazepine or for an opiate and another drug which may enhance the effects or the risks of drug abuse or overdose"*

Analytic Question 2: *"Does the addition of a prescription benzodiazepine to opioids increase the risk of fatal opioid-related overdose relative to taking opioids alone?"*

It is generally thought that there are more deaths from overdose in people who use more than one type of central nervous system depressant. To confirm this hypothesis, the PDMP dataset was linked to death certificates to analyze the death rates for those concurrently using opioid and benzodiazepines versus opioids only. The analysis was further refined with demographic break outs to allow for the relationships between drug combinations and demographic data. The linked dataset was analyzed for concurrent opioid and benzodiazepine prescriptions by individual and their demographics (age, gender, race, marital status, employment, and geography) to identify any relationship between the number and type of depressants taken and the likelihood of dying.

Table A2: Relative Risk of Opioid-Related Overdose (2013-2014) by Presence of Benzodiazepine in PDMP Records (2011-2014)			
Presence of Benzodiazepine vs. Risk of Fatal Opioid-Related Overdose	Opioids Only	Opioids + Benzodiazepines	Relative Risk Ratio
Fatal Overdoses	812	692	
Total Individuals	~2.1M	~0.4M	
Incidence	~2.0 per 10,000 per year	~8.4 per 10,000	~4.2
Summary	Based on observed data, the history of benzodiazepine concurrent with opioid prescriptions is associated with a 4-fold increase in risk of fatal opioid-related overdose		

Discussion: Preliminary findings support the hypothesis of increased risk of fatal opioid-related overdose associated with concurrent prescriptions for opioids and benzodiazepines. This risk factor should be clearly communicated to all prescribers and dispensers. Further analysis should be undertaken to see if mediating factors like demographics, previous treatment history, and co-morbid conditions like mental health histories increase or decrease this risk.

Limitations: The identifiers in the PDMP data set are imperfect. As such, it is highly likely that the instances of concurrent prescriptions for opioids and benzodiazepines are underestimated. There is no reason seen in the data that these undetected cases would substantially alter the conclusions drawn here. If anything, individuals using multiple forms of identification might logically be assumed to be at higher risk than those not attempting to avoid detection.

Statutory Question 3: *"The overall opiate prescription history of the individuals, including whether the individuals had access to legal prescriptions for opiate drugs at the time of their deaths"*

Analytic Question 3: *"Did opioid-related overdose decedents have access to legal opioids, defined as a prescription filled around time of death?"*

It is not known if there are more overdose deaths from misuse of prescribed medications or illegal drug use - drugs consumed by people for whom they were not prescribed. To ascertain the difference, the PDMP dataset was linked to death certificates to analyze the death rates for individuals with no scheduled medications[41]. The analysis was further refined with demographic break outs so relationships with demographic data could be examined. As in Question 2, the linked dataset was analyzed for opioid prescriptions by individual and their demographics (age, gender, race, marital status, employment, and geography) to identify any relationship between the number, type of opioid, and use of non-prescribed medication and the likelihood of dying of an opioid-related overdose.

Table A3a: Proportion of Opioid-Related Overdose Decedents (2013-2014) with Prescription for Opioids (2011-2014)			
Prescription in Same Month of Death vs. No Known Prescription	Rx in Month of Death	No Known Rx in Month of Death	Proportion
Fatal Overdoses	183	2009	8.3%
Summary	Based on observed data, 8.3% of opioid-related overdose decedents had an opioid prescription in the same month as their death		

Table A3b: Proportion of Opioid-Related Overdose Deaths by Toxicology Report Findings (2013-2014) (Mutually Exclusive Groups)		
Proportion of Opioid-Related Overdoses by Toxicology Report Findings	Fatal Overdoses	Percent of Fatal Overdoses
Fentanyl + Definite Heroin	166	9.8%
Fentanyl + Likely Heroin	83	4.9%
Fentanyl	288	17.0%
Definite Heroin	547	32.3%
Likely Heroin	320	18.9%
Methadone	84	5.0%
Other RX[1]	154	9.1%
Buprenorphine	15	0.9%

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[41] The Comprehensive Drug Abuse Prevention and Control Act of 1970 established an initial list of five classifications or schedules of drugs. The legislation also authorized two Federal agencies (the Drug Enforcement Administration and the Food and Drug Administration) to manage the five schedules and add or subtract drugs as needed.

Remainder[2]	35	2.1%
Summary	Based on observed data of opioid-related decedents with toxicology report findings approximately 83% had illicit or likely illicit substances in their system at time of death	

1. Other RX includes: Codeine (without Morphine), Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone, and Tramadol
2. Remainder includes: toxicology screen only included a non-specific "opiate" test and no specific drugs were mentioned and toxicology screen did not include an opiate

Table A3c: Contribution of Specific Drugs in Toxicology Reports (2013-2014)		
Contribution of Specific Drugs in Toxicology Reports	Fatal Overdoses	Percent of Fatal Overdoses[2]
Fentanyl	537	31.7%
Definite Heroin	713	42.1%
Likely Heroin	772	45.6%
Methadone	138	8.2%
Other RX[1]	358	21.2%
Buprenorphine	122	7.2%
Summary	Based on observed data, opioid-related decedents with toxicology reports, this table agrees with Table 3b in that greater proportions of opioid-related deaths contain illicit or likely illicit substances even after relaxing the mutual exclusivity constraint.	

1. Other RX includes: codeine (without morphine), Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone, and Tramadol
2. These are not mutually exclusive categories so this column adds to more than 100%

Discussion: These three tables are used to estimate the proportion of opioid-related fatal overdoses that are attributable to prescriptions. Table A3a examines prescription history in the same month of death as a way to infer if the decedent had "legal access to opioids" at time of death. Table A3b notes chemicals found in toxicology screen and is presented in decreasing order of deadliness of the specific drugs[42] (Fentanyl and/or Heroin > methadone > other Rx > buprenorphine) present in the results. A person was put into a category based on the most deadly drug present in the results, regardless of the presence of other drugs. For example, if someone had Fentanyl and methadone present, they would be in the "Fentanyl" group. These groups are mutually exclusive. For clarification, "likely Heroin" is determined based on evaluation of the toxicology data in combination with information on prescribing of Morphine from the PDMP. Toxicology screens were considered where Morphine was present in the

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[42] While "deadliness" is an imprecise term, drugs are considered deadlier when equivalent amounts are more likely to lead to death. In this case, equivalent amounts of Heroin or Fentanyl are more likely to result in death than buprenorphine.

absence of Codeine to indicate that the Morphine present was likely a metabolite of Heroin (and not prescription Morphine). A final important note regarding Table A3b is that in 14 of the 15 deaths where Buprenorphine was the only opioid present, the toxicology result was also positive for a benzodiazepine. Table A3c uses a similar identification methodology but relaxes the mutual exclusivity constraint. Both 3b and 3c, in tandem with 3a, lend support to an emerging hypothesis that illicit substances are the driving force behind opioid-related deaths.

Limitations: The identifiers in the PDMP data set are imperfect. As such, it is highly likely that the opioid prescription histories for some individuals are incomplete. Toxicology data also does not precisely identify all drugs. In some cases, metabolites of opioids may suggest that either a legal or illegal drug was ingested. However, there is no reason seen in the data that these limitations would substantially alter the conclusions drawn here.

Statutory Question 4: *"Whether the individuals had previously undergone voluntary or involuntary treatment for substance addiction or behavioral health."*

Analytic Question 4: *"Substance abuse treatment history (voluntary and involuntary) of Massachusetts residents who died of opioid-related overdose"*

Addiction treatment is intended to help individuals stop compulsive drug seeking and use by providing them with medication and behavioral coping skills as tools. Treatment can occur in a variety of settings, take many different forms, and last for different lengths of time. Because addiction is typically a chronic disorder characterized by occasional relapses, a short-term, one-time treatment is usually not sufficient. For many, treatment is a long-term process that involves multiple interventions and regular monitoring. There are a variety of evidence-based approaches to treating addiction. Treatment can include behavioral therapy (e.g. cognitive-behavioral therapy or contingency management), medications, or their combination. The setting for service delivery may be inpatient or outpatient. A clinical recommendation for treatment depends on the individualistic needs of a client.[43]

While most clients enter treatment voluntarily, some are committed to treatment through the court system. Section 35 of Chapter 123 of the Massachusetts General Laws provides a mechanism for a family member, police officer, physician, or court official to petition for a person whose alcohol or drug use puts themselves or others at risk to be involuntarily committed for substance abuse treatment. If the court approves the petition, the person is sent to the Women's Addiction Treatment Center (WATC) in New Bedford or the Men's Addiction Treatment Center (MATC) in Brockton to receive up to 90 days of inpatient substance abuse treatment similar to a combination of Acute Treatment Services (detoxification) and Clinical Stabilization Services. There has been a significant increase in the number of commitments through Section 35 in recent years. In 2007 there were 1,086 individuals committed through Section 35. In 2015 that number was 3,651.Given the increasing number of commitments it is important to assess the effectiveness of the involuntary commitments in reducing adverse consequences, specifically fatal opioid-related overdoses. The current analysis measures the risk of fatal opioid-related overdose for those with a history of involuntary commitment. Death certificate data from 2013-2014 were linked to treatment data from the Bureau of Substance Abuse Services (BSAS) from 2011-2014. The analysis was further refined with demographic break outs to identify any age differences.

Results: Of the 149,351 clients served between 2011 and 2014 in the BSAS treatment system, 9,464 people were committed to involuntary treatment. Clients who had ever been admitted through Section 35 were 88% White non-Hispanic, 58% male and had a median age of 32 years old. In contrast, clients

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[43] There are evidence-based guidelines from SAMHSA and associations like American Society of Addiction Medicine (ASAM) and American Psychological Association (APA) for particular treatment services and for particular populations. For instance, there are guidelines for clinically evaluating patients to determine what is medically necessary and determine individualistic needs. The guidelines outline standards of care for stabilizing patients with withdrawal symptoms during detoxification and there are recommendations for maintenance care. The guidelines also specify MAT dosing for detoxification purposes as well as maintenance. Often, people with severe addiction are poly-substance users and require treatment for all substances abused.

with only a voluntary treatment history were 75% White non-Hispanic, 68% male and had a median age of 37 years old.

Based on admissions during the study period, 67% of clients with a history of involuntary treatment had at least one opioid-related admission, 83% reported prior mental health treatment, and 44% reported a prior overdose. For clients with only a voluntary treatment history, 46% had at least one opioid-related admission, 58% reported prior mental health treatment, and 18% reported a prior overdose. Clients who received involuntary treatment were 2.2 times as likely to die of opioid-related overdoses and 1.9 times as likely to die of any cause compared to those with a history of voluntary treatment only.

Table A4: Risk of Opioid-Related Overdose Death (2013-2014) by Treatment Status (2011-2014)		
Treatment Type and Risk of Fatal Opioid Overdose	Voluntary Treatment	Involuntary Treatment
Fatal Overdoses	892	134
Total Individuals	139,887	9,464
Percent Fatal Overdoses	0.63%	1.4%

Discussion: Individuals afflicted with substance use disorders often don't acknowledge having a substance use problem nor seek treatment until they have significant health and social issues as a consequence of their compulsive behavior associated with their addiction. This means that most of the individuals presenting to treatment – voluntary or involuntary – have a multitude of social, behavioral, and health issues. For example, of the BSAS treatment population included in this study 58% reported prior mental health history. That number was even higher for those committed through Section 35 (83%). Section 35 permits the courts to involuntarily commit someone whose alcohol or drug use puts themselves or others at risk. Therefore, most individuals admitted through Section 35 are not necessarily ready for treatment. Table A4 provides evidence of significant differences in outcomes between those that received voluntary treatment and those that were committed to treatment involuntarily. A higher percentage of those that had a history of involuntary treatment died of an opioid-related overdose compared to those without a history of involuntary treatment. The differences in history of prior mental health treatment and nonfatal overdoses may indicate that these clients have complex co-morbid conditions and are at a higher risk of fatal overdose. There are significant limitations in both the mental health and substance abuse treatment systems in addressing the dually diagnosed. Mental health clinicians' knowledge of substance use disorders and overdose prevention is necessary given the significant overlap between these two populations. The same is true about substance abuse providers.

Further analysis must be conducted to assess other underlying risk factors, i.e.; prescription history, drugs of choice, co-morbid disorders (e.g., mental health conditions), and demographics that may put this subpopulation at a higher risk for overdose. However, the preliminary findings are not surprising given the involuntary nature of Section 35 and thus potential lack of client treatment readiness. Future analysis should also investigate the impact on risk of overdose death of the length of

engagement as well as the transition to step down services following voluntary and involuntary acute services.

Limitations: This analysis does not include all Section 35 commitments in the Commonwealth, only those admitted through WATC and MATC, which are facilities licensed and operated under contracts from MDPH. A significant portion of people committed were sent to the Massachusetts Committing Institution (MCI) in Framingham and the Massachusetts Alcohol and Substance Abuse Center (MASAC) in Bridgewater during this time period. As a result, the findings may not fully reflect the risk of overdose for this population. Furthermore, BSAS data does not represent all substance abuse treatment provided in the Commonwealth. BSAS only collects data from its contracted providers. Of the data that is submitted to BSAS, outpatient treatment data is incomplete and does not include all non-BSAS-paid services. BSAS does not collect data from providers that prescribe Vivitrol or from non-contracted buprenorphine providers. Including substance abuse treatment data captured in other systems such as APCD may help refine these findings.

Statutory Question 5: *"whether the individuals had attempted to enter but were denied access to treatment for substance addiction or behavioral health."*

Analytic Question 5: *"Does denial of service lead to an increased risk of fatal opioid-related overdose?"*

This analysis could not be conducted with the data currently available. Addiction is a complex problem partially because there is no single path to recovery. People with addiction can recover on their own without any treatment; some use self-help strategies to recover while others enter formal treatment.[44] Evidence suggests that few people with addiction actually seek treatment, and for those that do, they often wait for many years before entering treatment.[45] Only about 10% of individuals with a substance use disorder have had any treatment.[46] This lack of treatment for those in need is unlike any other area of health care. By comparison, approximately 50% of those with a mental health disorder receive treatment.[47,48] In 2014, the Substance Abuse and Mental Health Service Administration (SAMHSA) estimated that nationally 19.9 million persons aged 12 or older needed substance use treatment but did not receive specialty treatment in the past year. Of these 19.9 million persons, only 798,000 reported that they perceived a need for treatment for their use of illicit drugs or alcohol; this corresponds to about 4.0 percent of those that needed treatment. Thus, the large majority of the roughly 20 million people aged 12 or older who needed substance use treatment but did not receive specialty treatment did not perceive a need for treatment. Of the 798,000 persons who perceived a need for treatment, only a small percentage made an effort to get treatment (Figure A5).[49]

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[44] Klingemann and Sobell, 2007; Shaffer, 2007; Shaffer and Jones, 1989; Slutske, 2006; Sobell et al., 1996

[45] Kessler, R. C., Aguilar-Gaxiola, S., Berglund, P. A., Caraveo-Anduaga, J. J., DeWit, D. J., Greenfield, S. F., ... & Vega, W. A. (2001). Patterns and predictors of treatment seeking after onset of a substance use disorder.*Archives of general psychiatry*, *58*(11), 1065-1071.

[46] Substance Abuse and Mental Health Services Administration. R*esults from the 2014 National Survey on Drug Use and Health: Summary of National Findings. R*ockville, MD: Substance Abuse and Mental Health Services Administration; 2015.

[47] Honberg R, Diehl S, Kimball A, Gruttadaro D, Fitzpatrick M. S*tate mental health cuts: A national Crisis. N*ational Alliance on Mental Illness2011.

[48] Mental Health America. Position Statement 14: The Federal Government's Responsibilities for Mental Health Services. 2011; http://www.mentalhealthamerica.net/positions/federal-role.

[49] Accessed at http://www.samhsa.gov/data/sites/default/files/NSDUH-DR-FRR3-2014/NSDUH-DR-FRR3-2014/NSDUH-DR-FRR3-2014.htm (figure 15 and 21)

Figure A5: Perceived Need for Substance Use Treatment among People Aged 12 or Older Who Needed Substance Use Treatment But Did Not Receive Substance Use Treatment in the Past Year (2014)

96%

1%
3%

■ Did Not Feel They needed Treatment

■ Felt They Needed Treatment and Did Make an Effort

■ Felt They Needed Treatment and Did Not Make an Effort

19.9 million needing but not receiving treatment
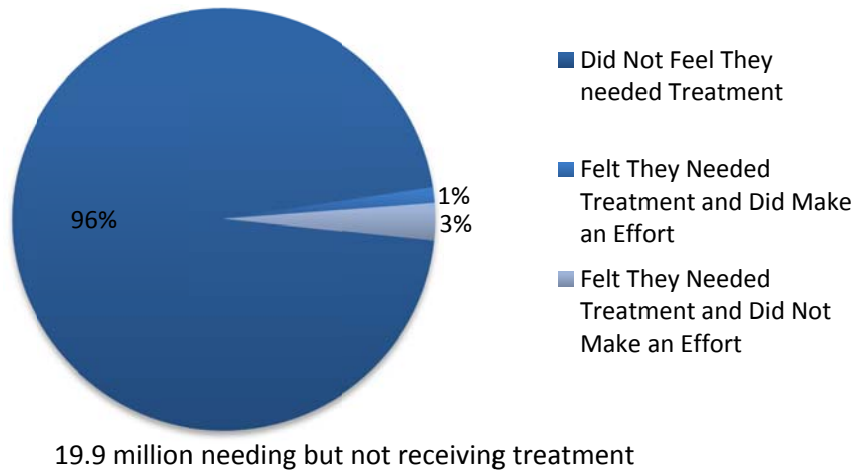
For individuals who would like to access treatment, a number of factors can complicate their access to care, including: homelessness, unemployment, childcare, criminal involvement, cost, wait time, distance to treatment, and other barriers that inhibit placement in treatment.

Historically, limited residential bed capacity created a bottleneck in the transition of clients from more acute levels of care into less intensive levels of treatment. As a result, providers created their own waitlists and maintained contact with clients awaiting residential beds. While this helped individual providers in serving their own clients, the redundancy of these lists made it impossible to measure the extent of unmet need throughout the state. BSAS constantly strives to better understand issues associated with access to treatment in Massachusetts. Under a current initiative, the Massachusetts Substance Abuse Helpline will maintain a centralized waitlist management process for residential treatment. The Substance Abuse Helpline tracks individual admissions into programs and will allow BSAS to report the unduplicated number of people across the state waiting for residential treatment as well as wait time.[50]

This BSAS initiative is the beginning of addressing issues associated with access to treatment. Similar initiatives must be supported to collect access-related information throughout the system. While waitlists will help to assure that most programs run at their full capacity, uniform and standardized assessment is necessary to make sure that clients admitted meet the clinical criteria for each level of care. Those not meeting the clinical criteria for residential levels of care should be redirected to appropriate treatment and wrap-around services such as housing and case management.

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[50] Accessed at http://helpline-online.com/

Statutory Question 6: *"whether the individuals had received past treatment for a substance overdose."*

Analytic Question 6: *"Are those who have had a nonfatal opioid-related overdose more likely to die from a fatal opioid-related overdose?"*

It is assumed that people with substance use disorders who have a history of treatment for nonfatal opioid-related overdoses are at higher risk for eventually dying of an opioid-related overdose. As such, a history of past treatment would be a marker for individuals at higher risk for death from an overdose. There are two datasets that must be used to identify nonfatal opioid-related overdoses: the Massachusetts Ambulance Trip Record Information System (MATRIS) and Acute Case Mix. An algorithm that utilizes several pieces of information in MATRIS creates a flag to indicate opioid-related incidents. Both Case Mix and MATRIS data have been linked with death data where possible. A gap in this data is that MATRIS does not include information on opioid-related overdoses where an ambulance was not called. Case Mix data, which includes information on Emergency Department visits, Hospitalizations, and Observation stays, can be used to both corroborate the incidence of an opioid-related overdose in MATRIS and also to identify opioid-related overdoses that occurred when a person did not take an ambulance to the hospital. This data can also be linked with deaths in order to determine if the opioid-related overdose was fatal or not. None of our data systems can account for an opioid-related overdose where a person did not take an ambulance and did not end up in a Massachusetts hospital (i.e. a person who was revived with Naloxone by a friend or family member and did not seek additional treatment.)

Results: Using ICD9 codes[51], 6,335 individuals were recorded as having opioid overdoses in the Case Mix data file. Overdoses were recorded for these 6,355 people in 9,621 different months thus indicating that there were at least 1.5 overdoses per person using Case Mix data alone. *Since the Chapter 55 Case Mix data records only that one or more events occurred within a month and not the total number of events, it is not possible to compute a more accurate estimate of the average.* In Case Mix data, 71% had only one overdose. Of these, 3.7% died of an opioid-related overdose at some point in 2013 or 2014. Similarly, 29% had more than one overdose in Case Mix. Of these, 6.3% died of an opioid-related overdose at some point in 2013 or 2014. See Table A6a.

Table A6a: Overdoses by Person in Case Mix Data, Massachusetts (2011-2014)				
Total ODs	**Number**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	4,490	70.9	4,490	70.9
2	1,127	17.8	5,617	88.7
3	389	6.1	6,006	94.8
4	171	2.7	6,177	97.5
5 or more	158	2.5	6,335	100.0

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[51] The following ICD9 codes were used: 96500, 96501, 96502, E8500, E8501, E8502.

Using an algorithm developed in collaboration with the Centers for Disease Control and Prevention (CDC), 8,859 individuals were identified as having had a likely overdose from the MATRIS data. There were 10,995 overdoses recorded for these 8,859 individuals, thus indicating that there were 1.2 overdoses per person using the MATRIS data alone. *In MATRIS,* 83% had only one likely overdose. Of these, 4.5% died of an opioid-related overdose at some point in 2013 or 2014. Similarly, 17% had more than one likely overdose in MATRIS. Of these, 5.4% died of an opioid-related overdose at some point in 2013 or 2014. See Table 6b.

Table A6b: Overdoses by Person in MATRIS, Massachusetts (2013-2014)				
Total ODs	**Number**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	7,344	82.9	7,344	82.9
2	1,134	12.8	8,478	95.7
3	242	2.7	8,720	98.4
4	82	0.9	8,802	99.4
5 or more	57	0.6	8,859	100.0

Finally, when Case Mix and MATRIS data were examined together, there were 13,154 people recorded as having or likely having an overdose event in 2013 or 2014. Although it is likely an underestimate for the reasons stated above, these overdose events occurred 20,619 event-months thus indicating that on average each individual had 1.5 overdose events per person. In Case Mix and MATRIS, 15% of the individuals had one or more overdose events recorded. Of these, 5.4% died of an opioid-related overdose at some point in 2013 or 2014. One-third (33%) of individuals with recorded overdose events could be found only in the Case Mix data. Of these, 4.0% died of an opioid-related overdose during 2013 or 2014. Slightly over half (52%) of individuals with recorded overdose events could be found only in the MATRIS data. Of these, 4.4% died of an opioid-related overdose during the study period.

Altogether, 9.3% of people with a fatal opioid-related overdose had at least 1 prior nonfatal overdose event recorded in either Case Mix or MATRIS. No differences were found by gender. In other words, the likelihood of subsequent opioid related death when preceded by a nonfatal overdose was the same for men and women. There were, however, differences by age. Compared to people aged 45+, those aged 27 and under and those 28 to 34 were nearly twice as likely to have a previous overdose event before death.

Discussion: There are at least 5 times as many nonfatal overdose events compared to fatal opioid-related overdose deaths. Each should be considered an opportunity to reduce the risk of subsequent opioid-related death. While the available data shows that a relatively small number of nonfatal overdoses precede a fatal overdose (9.3%), it is believed that this number is a significant underestimate. See the Limitations discussion below. Regardless, all opportunities should be explored to reduce the

opioid overdose death rate. For example, Emergency Medical Services (EMS) could receive alerts about high-risk communities or high-risk patient profiles. Heightened awareness could positively impact the death rate. Hospitals and EMS alike could be advised about the importance of reporting accurate data about fatal and nonfatal overdose deaths, so trends can be identified and addressed as soon as possible. Finally, since the majority of overdose events are only found in Case Mix data or MATRIS data but not in both, this suggests that a substantial number of people seek no treatment whatsoever following a nonfatal overdose. Educating users, friends, family members, and bystanders about the importance of seeking medical treatment following a nonfatal overdose is critical if the number of deaths is to be reduced.

Limitations: While only 9.3% of the individuals who had a fatal opioid-related overdose also had at least 1 prior nonfatal overdose event, it is very likely that this value is a significant underestimate of the actual number of opioid overdoses prior to opioid death that occurred in Massachusetts during 2013 and 2014. First of all, the Chapter 55 data was organized by months to protect the privacy of the individuals whose data was analyzed. Any nonfatal overdose occurring in the same calendar month as a fatal overdose would be masked and thus undercounted. Second, MATRIS data has known gaps. Some emergency medical services do not report data and others do not routinely record data that is sufficient for the algorithm to flag an ambulance trip as a likely overdose case. As least 30% of MATRIS data is missing in whole or in part. On this measure alone, it is almost certain that the actual number of individuals with overdose events preceding death far exceeds what is reported here. Third, Case Mix data is also likely to underestimate the total number of overdose cases. There could be coding errors, different coding approaches used by different hospitals, or possible physician concerns for patient privacy that could result in incomplete counts of overdose reporting in hospital settings. Finally, there are numerous testimonials of persons who survived an overdose after a being revived with Naloxone by a friend or family member. Anecdotal evidence suggests that many of these individuals did not seek additional treatment and thus were not included in the two data sets examined here. These individuals may have refused care by an EMT, refused to enter a hospital Emergency Department, or never sought any treatment whatsoever. Mathematical modeling of the full array of data available through Chapter 55 could shed some additional light on the percentage of cases. That work is ongoing.

Statutory Question 7: *"Whether any individuals had been previously detained or incarcerated and, if so, whether the individuals had received treatment during the detention or incarceration."*

Analytic Question 7: *"Does treatment during incarceration reduce likelihood of a fatal opioid-related overdose?"*

It is considered best practice to provide individuals that have a substance use disorder (SUD) with treatment as swiftly as possible. Furthermore, for individuals who are incarcerated and have a SUD, providing treatment behind the walls would be the optimal time to do so rather than waiting until release. It is hypothesized that those that receive SUD treatment behind the walls are less likely to die of an opioid-related overdose post-release in comparison to those that do not receive treatment prior to release. To confirm this hypothesis, an analysis was conducted by linking Massachusetts Department of Correction (DoC) data (jails are not included), which includes drug treatment received during incarceration in prison to death certificate data and the individual's demographic information.

There is a large overlap between people involved in the criminal justice system and people who use substances. In a survey of State and Federal prisoners, the Department of Justice's (DOJ) Bureau of Justice Statistics (BJS) estimates that about half of the prisoners in the US meet Diagnostic and Statistical Manual for Mental Disorders (DSM) criteria for substance use disorders, and yet fewer than 20 percent who need treatment receive it.[52,53] Of those surveyed, 14.8 percent of State and 17.4 percent of Federal prisoners reported having received drug treatment since admission.[54]

Inmates released from correctional facilities are at an increased risk of overdose;[55] this increased risk is due to a multitude of factors. First, evidence–based, individualized treatment may not be available within the correctional facilities. Second, due to prolonged abstinence and the resulting reduction in tolerance, a similar dose as the one used prior to incarceration may pose a significantly high risk of overdose. A large study conducted in Washington State found that within the first two weeks after release, the rate of death from overdose was 1,840 per 100,000 person-years (95% confidence interval, 1213 to 2677). In the Washington State study, inmates were 129 times as likely to die of an overdose compared to other state residents in the first two weeks after release. [56] The cases in this study were in the state system and did not include jails or houses of correction; which is very similar to Massachusetts.

During incarceration there is an opportunity to engage inmates with a substance use disorder in treatment. Of those surveyed by BJS, 14.8% of State and 17.4% of Federal prisoners reported having

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[52] Chandler RK, et. Al.. "Treating drug abuse and addiction in the criminal justice system: improving public health and safety." *Jama* 301.2 (2009): 183-190.

[53] Mumola CJ, et. Al.. "Bureau of Justice Statistics special report." *Washington, DC: Department of Justice* (2006).

[54] Ibid.

[55] Glaze L. E., Keuble D. Correctional Populations in the United States, 2013. Washington, DC: Bureau of Justice Statistics; 2014.

[56] Ingrid A. Binswanger, M.D., Marc F. Stern, M.D., Richard A. Deyo, M.D., Patrick J. Heagerty, Ph.D., Allen Cheadle, Ph.D., Joann G. Elmore, M.D., and Thomas D. Koepsell, M.D. Release from Prison – A High Risk of Death for Former Inmates.N Engl J Med 2007; 356:157-165January 11, 2007. http://www.nejm.org/doi/full/10.1056/nejmsa064115#t=articleTop

received drug treatment since admission.[57] It is also critical to refer them to community-based substance abuse treatment programs upon release to reduce the risk of overdose. Further analysis of linking DoC data with BSAS data will indicate whether inmates with a substance use disorder are: a) receiving treatment while incarcerated; and b) referred and subsequently admitted to the appropriate community-based treatment.

According to the National Institute on Drug Abuse (NIDA)[58], "only a small percentage of offenders have access to adequate services, especially in jails and community correctional facilities. Not only is there a gap in the availability of these services for offenders, but often there are few choices in the types of services provided. Treatment that is of insufficient quality and intensity or that is not well suited to the needs of offenders may not yield meaningful reductions in drug use and recidivism. Untreated substance abusing offenders are more likely than treated offenders to relapse to drug abuse and return to criminal behavior. This can lead to re-arrest and re-incarceration, jeopardizing public health and public safety and taxing criminal justice system resources. Treatment is the most effective course for interrupting the drug abuse/criminal justice cycle for offenders with drug abuse problems."[59]

Results: The DoC data includes people that were incarcerated and released during the study period (n = 25,209). 25% of the sample received treatment for substance abuse behind the walls. 12% of the fatal opioid overdose records linked with DoC data.

Table A7: Risk of Fatal Opioid Related Overdose by Treatment during Incarceration Status (2013-2014)		
Treatment Status vs. Risk of Fatal Opioid Overdose	Treated while Incarcerated	Not Known to Have Been Treated while Incarcerated
Fatal Overdoses	37	84
Total Population	3758	10160
Incidence	~49.2 per 10,000 per year	~41.3 per 10,000 per year
Summary		There does not appear to be a large difference between treated versus not known to have been treated amongst those incarcerated during study period.

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[57] Mumola CJ and Karberg JC. Drug Use and Dependence State and Federal Prisoners. Accessed at: http://proxychi.baremetal.com/csdp.org/research/dudsfp04.pdf
[58] Accessed at https://www.drugabuse.gov/publications/principles-drug-abuse-treatment-criminal-justice-populations/introduction
[59] Ibid.

Discussion: There does not appear to be a difference in incidence of opioid-related overdose between those treated for SUD and those not known to have been treated for an SUD while incarcerated. Further analysis is needed to determine the risks associated with being incarcerated and risk of overdose.

A significant opportunity is missed in engaging these clients in substance abuse treatment while they are incarcerated. Recommendations for improving services and increasing understanding of these associations include:

- Increase the quantity and quality of substance abuse treatment within DoC facilities.
- Increase education for overdose prevention (e.g. abstinence while incarcerated and relapsing upon release poses a risk for overdose).
- Improve integrated mental health and substance use disorder treatment plan prior to release date, and ensure individuals are linked with these community supports at time of release.
- DoC data only includes a subpopulation of the individuals incarcerated in Massachusetts. This may impact the rates presented in Table A7. Future analyses using more comprehensive criminal justice data would shed better light on the associations between incarceration and risk for overdose.

Limitations: There are some limitations associated with using DoC data to better understand the intersection of opioid overdoses and criminal justice involvement in the Commonwealth. Even though there is a large overlap between those that are criminally involved and have a SUD, there is a large assumption in this analysis - not everyone who is incarcerated is in need of substance abuse treatment.

The treatment indicator within the DoC data does not specify the type of treatment an individual received, and it may in fact include self-help groups. The indicator also does not specify the date when the treatment was received; therefore, it is hard to determine for those that had a lengthy sentence whether the treatment was received closer to the beginning or end of a sentence, which may impact the overdose outcome.

DoC data includes incarcerations for those in prison and does not include data for people in jails or houses of correction (HoC). The data from DoC used in this analyses (e.g. those incarcerated during the study period and released) is only a subset of the individuals incarcerated within Massachusetts during this study period. This analysis does not included individuals that were not released during the study period, and it does not include individuals incarcerated within HoC. HoC servers a higher volume of inmates per year in comparison to DoC, primarily due to shorter sentences and those waiting trial within HoC. Due to this limitation, using DoC data to understand the intersection between fatal opioid overdoses and the criminal justice system in Massachusetts does not provide a full picture to determine associated risks. An additional limitation arises if residents of Massachusetts are incarcerated outside of Massachusetts, as that data is not captured by the DoC.

Appendix B: Dataset Descriptions

The following is a description of each of the ten datasets used for this report. Each description outlines the information collected, the frequency, the limitations, the lag time between data collection and data availability, the relevance to opioids, and the authorization for collecting the data. It is of note that *all* of the datasets are authorized through Massachusetts legislation, however, this is the first time these datasets have been used together to depict a more accurate and holistic picture of a public health problem.

Registry of Vital Records and Statistics (RVRS)[60] – Death Records[61]

What data are collected: Opioid-related deaths are the primary focus of this work and the most basic source of this information comes from death certificates filed with the Registry of Vital Records and Statistics (RVRS). The official cause of death and the manner of death (i.e., intentional, unintentional, or undetermined) are assigned by physicians and medical examiners. Each death certificate also includes demographic information such as age, race, Hispanic ethnicity, gender, educational attainment, marital status, and occupation. These basic demographics are recorded by the funeral director and are typically provided by a family member.

Availability of data: Mortality information is reported electronically using the Vitals Information Partnership[62] (VIP). The VIP system is web-based and receives information 24 hours a day seven days a week. For analytic purposes, data can be exported from VIP with all the data elements listed above. Opioid-related deaths and other complex cases are almost always referred to the Office for the Chief Medical Examiner (OCME) for determination of cause and manner of death. This results in a reporting lag for these deaths. That said, basic data on demographics is available on a near-real time basis.

Limitations of the data: As legal records, the information recorded on death certificates is considered highly accurate. However, some information like race, Hispanic ethnicity, educational attainment, marital status, and occupation are not always fully populated. Causes of death from the OCME often lag the date of death making some elements of death data less timely than others.

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[60] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/vitals/
[61] The collection of death certificate data is authorized by MGL Chapter 46.
[62] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/vitals/vitals-information-partnership-vip.html

Bureau of Substance Abuse Services (BSAS)[63] – Substance Abuse Treatment Data[64]

What data are collected: Massachusetts Bureau of Substance Abuse Services (BSAS), of the Department of Public Health, is the single state authority responsible for regulating and licensing substance abuse treatment providers. The services provided range from acute detoxification to residential and outpatient based services. All treatment providers who receive funding from BSAS are required to submit data to BSAS to carry out the responsibilities listed under the law. The required data fields include but are not limited to: client characteristics, enrollment information, disenrollment information, services and outcomes. Currently, only treatment providers that receive funding from the Department submit this data to BSAS.

Availability of data: Processing of linked clients also allows us to construct treatment episodes and entire client histories. There is a 1-2 month lag between the time the data are reported and the time it is available for analysis/reporting from BSAS.

Limitations of the data: The BSAS data set poses several limitations. First, BSAS data does not represent all substance abuse treatment provided in the commonwealth. BSAS only collects data from its contracted providers. Of the data that is submitted to BSAS, outpatient treatment data is incomplete and does not include all non-BSAS paid services BSAS does not collect data from providers that prescribe Vivitrol or from non-contracted Buprenorphine providers. At the time of this analysis, Methadone data was incomplete. Due to challenges associated with recent system changes related to data submission, some Methadone providers have been unable to submit data. Data collected in regards to section 35 commitments are incomplete in the BSAS data set. For example, in 2015 there were 2,068 of Section 35 commitments were served in settings that are outside the scope of data submitted to BSAS (e.g. MASAC and MCI Framingham). As a result of these data limitations, it is possible that some of the analyses using BSAS treatment data may provide an incomplete picture.

Prescription Drug Monitoring Program (PDMP)[65] – Schedule II through V medications[66]

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[63] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/substance-abuse/
[64] The collection of detailed substance abuse treatment by BSAS is authorized under MGL Ch.111 B and E. All treatment providers are required to submit data to BSAS to carry out the responsibilities listed under the law. The regulations promulgated to carry out these responsibilities require the providers to submit data in a timely manner. The required data fields include but are not limited to: client characteristics, enrollment, disenrollment information, services and outcomes. Currently, only treatment providers that receive funding from the Department submit the required data to BSAS. BSAS uses this data for billing/payment and service planning purposes. Almost all BSAS licensed/contracted providers enter the required data through the Virtual Gateway. Assessment data collected at admission and disenrollment are entered into Enterprise Invoice Management/Enterprise Service Management (EIM/ESM) system daily or in batches. Data entry occurs at provider sites and is transmitted to BSAS on a monthly basis. The current database includes data from Fiscal Year 2000-2016. BSAS can readily report data at the provider level, the enrollment level, and the client level.
[65] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/hcq/drug-control/PDMP/
[66] The Department of Public Health's Office of Prescription Monitoring and Drug Control (OPMDC) established the Massachusetts Prescription Monitoring Program (MA PDMP) in 1992 pursuant to joint regulations (105 CMR 700.012) with the Board of Registration in Pharmacy (247 CMR 5.04).

What data are collected: Information about filled prescriptions for schedule II through V medications is reported electronically each business day to the Prescription Drug Monitoring Program (PDMP) in the Department of Public Health's Office of Prescription Monitoring and Drug Control (OPMDC) by all Massachusetts community, hospital outpatient and clinic pharmacies as well as from out-of-state mail order pharmacies that deliver to patients in Massachusetts. Schedules II through V medications consist of those prescription drug products with recognized potential for abuse or dependence (e.g., narcotics, stimulants, sedatives). Consequently, they are among those most sought for illicit and non-medical use. The specific medication as well as the dosage and the number of pills or amount are also captured. In order to facilitate the monitoring of individuals who receive scheduled medications, basic identifying information like full name, gender, date of birth, and full address are also recorded as well as information about the prescriber and dispensing pharmacy.

Availability of data: PDMP reporting is comprehensive for pharmacies within the Commonwealth with very few instances of non-compliance among pharmacies. PDMP data arrives daily and is considered complete and accurate for export and analysis within approximately two weeks.

Limitations of the data: The PDMP dataset has a few noteworthy limitations. First, methadone clinics do not report to the Massachusetts PDMP as they are exempt by statutory language. Specifically, the PDMP only collects data on prescriptions dispensed, and methadone in clinics is administered pursuant to medical order, not prescription. Methadone is only include when prescribed for pain. Second, controlled substance prescriptions dispensed by Veterans Administration (VA) facilities are not included. This represents a high risk population and a significant data gap. Third, prescription drugs that are obtained illegally (e.g., stolen, purchased on the street, etc.) are a potentially significant contributor to the opioid overdose epidemic and are not captured within an individual's PDMP history, but may be captured by the OCME toxicology screens. Finally, a filled prescription should not be interpreted to mean that an individual took all or even any of that medication. Linking these records with toxicology data can provide some insight into the proportion of scheduled medications that are illegally diverted for other purposes than originally intended.

Massachusetts Ambulance Trip Record Information System (MATRIS)[67] – Office of Emergency Medical Services (OEMS)[68]

What data are collected: The Department of Public Health's Office of Emergency Medicine (OEMS) established the Massachusetts Ambulance Trip Record Information System (MATRIS) in December 2010 as a statewide system collecting emergency medical service (EMS) incident data from licensed ambulance services. Under EMS System regulations, ambulance services are required to document each EMS call and include the data elements pertaining to the call that are specifically referenced in an administrative requirement issued by OEMS governing the statewide EMS minimum data set. MATRIS data elements are based on the National Emergency Medical Service Information System

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[67] For more information see: www.mass.gov/dph/oems/matris
[68] The collection of detailed ambulance trip data by OEMS is authorized under 105 CMR 170.345(B).

(NEMSIS) Version 2.2.1 dataset standard developed in 2005. This includes demographic, clinical, operational, and billing data. Demographics required are patient age, birth date, gender, and patient home address. Also required are incident type, incident address, dates, times, destination facility type, destination facility name, and destination facility address. Patient name is not currently required but is submitted approximately 70% of the time. MATRIS can identify nonfatal-opioid-related events, even when the patient refuses transport to the hospital. MATRIS tracks when naloxone was administered either by the EMT or as "prior aid" by other first responders, (fire, police) or bystanders (friends, family). Evaluation on interventions provided by EMTs can be performed to correlate survival and other outcome rates when linked with outcomes from ED and death data.

Availability of data: Ambulance incident information is to be submitted into the MATRIS secure website electronically from all licensed ambulance services in Massachusetts within 14 days of the call; however frequency of submission varies by service. Many of the larger ambulance services have automated daily submission, while others can take longer to submit. There are currently over 6.4 million ambulance trip records in MATRIS. There were 1.3 million records in MATRIS for incidents occurring in both 2013 and 2014. There are 1.4 million for 2015 available for future analysis.

Limitations of the data: MATRIS has several limitations. The first is that the NEMSIS standard does not specifically identify incidents as being opioid-related, but rather "poisoning/ingestion". The second, the data are not uniformly reported by EMS providers. The third limitation is that the overall usability of the data submitted by ambulance services varies by provider, with roughly 30% of the provided data being partially or completely unusable. These issues are partially mitigated through the integration with other datasets listed above. Finally, whether a specific ambulance trip involves an opioid overdose is not a simple judgment. The classification of opioid trips was based on an algorithm developed in conjunction with the Centers for Disease Control and Prevention. Their assistance was invaluable.

Registry of Vital Records and Statistics (RVRS)[69] – Birth Records[70]

What data are collected: The collection and dissemination of this data are to facilitate the surveillance of births and birth trends in the state of Massachusetts, including those based on demographic information and data on birth outcomes. Data are reported to the Registry of Vital Records and Statistics (RVRS) by all licensed birthing hospitals and birthing centers and by city and town clerks if they are establishing a home birth that occurred in their city/town in Massachusetts. The birth data contains identifying information about the parents of record and the child. These data are critical to understand the health risk to a mother who delivers a Substance Exposed Newborn (SEN) or an infant with Neonatal Abstinence Syndrome (NAS).

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[69] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/vitals/
[70] The collection of Confidential Birth Information is authorized under 105 CMR 350.000.

Availability of data: Natality information is reported electronically using the Vitals Information Partnership (VIP).[71] The VIP system is web-based and receives information 24 hours a day, seven days a week. Substantial quality control efforts are required to assess the accuracy and completeness of birth records. As a result, the final dataset of birth records is usually available by May of the following year.

Limitations of the data: As legal records, the information recorded on birth certificates is considered highly accurate. However, some information like race and Hispanic ethnicity are not always fully populated.

Massachusetts Cancer Registry (MCR)[72] – Cancer Staging[73]

What data are collected: The Massachusetts Cancer Registry (MCR), a database managed by the Department of Public Health, is a population-based registry that tracks the incidence of cancer within the Commonwealth. Since 1982, the MCR has captured key data elements such as date of diagnosis and cancer stage at diagnosis, in addition to various demographic data elements. For this purposes of this work, MCR data was included because palliative treatment for late stage cancers often includes the use of opioid medications to control pain. Being able to distinguish those cases of high opioid use for cancer treatment from cases where an individual may be abusing prescription medications was critical to this study.

Availability of data: Reporting facilities are required to report case level data to the MCR within 180 days of diagnosis or first date of patient interaction. Analysis of supporting documentation related to determining the *stage* of a cancer also takes considerable time. Typically, MCR data availability lags the calendar by approximately two years.

Limitations of the data: Defining the stage of a cancer is not an exact science. It is based on a number of written reports and laboratory tests. Furthermore, not all cancers cause significant pain even in late stages. These data can provide an indication that medications may have been prescribed for pain but they cannot definitively rule out the possibility that there was underlying abuse.

Office of the Chief Medical Examiner (OCME)[74] – Circumstances of Death and Toxicology Reports[75]

What data are collected: The OCME, a part of the Executive Office of Public Safety and Security, gathers a great deal of information about unattended and other deaths where the underlying causes may not be apparent. Not of all of the information collected is relevant to opioid overdose deaths,

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[71] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/vitals/vitals-information-partnership-vip.html
[72] Accessed at http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/cancer-registry/
[73] The collection of detailed cancer incidence and staging by the MCR is authorized under Chapter 111, Section 111B.
[74] Accessed at http://www.mass.gov/eopss/agencies/ocme/
[75] The collection of death certificate data is authorized by MGL Chapter 38.

so the work reported here has focused on the *circumstances of death* recorded on the OCME intake forms and the toxicology reports used to determine the cause of death. The data field labeled "*circumstances of death*" *i*s a brief narrative that describes the setting and environment of an unattended death. It is often written by the State Police in the case of acute opioid overdoses. These narratives are analyzed by searching for the presence of key words. The toxicology reports describe the presence of hundreds of specific chemical compounds that might be found in the body of the decedent. This study has focused primarily on the presence of natural and synthetic opioids.

Availability of data: The intake forms that contain the *circumstances of death* narratives are usually available within about 72 hours of a case being accepted by the OCME. Toxicology screening and confirmatory tests are conducted by the Crime Laboratory run by the Massachusetts State Police as well as the NMS Labs (Willow Grove, PA). Toxicology tests lag the date of death by about 60 days.

Limitations of the data: Written narratives will provide initial impressions of the circumstances of death. As first impression, these can be misleading in some cases. Final causes of death must be provided by physicians and medical examiners. Toxicology results can be extremely complex to interpret. Levels of drugs found a decedent's tissue are affected by the timing of the test, the type of tissue, and other factors. Many drugs also metabolize into a variety of different chemical compounds. For all these reasons, toxicology results are generally examined in broad categories to simplify interpretation. OCME data are connected directly to the death records using the unique OCME ID number. OCME and RVRS death records link nearly 100% of the time. Finally, the vast majority of the toxicology records for early 2013 were only available on paper and thus not practical to include in this report.

Case Mix Database[76] – Inpatient hospitalization, emergency department visits, and outpatient observations managed by the Center for Health Information and Analysis (CHIA)[77]

What data are collected: The Case Mix data contains all inpatient hospitalizations, emergency department visits, and outpatient observation in the state. Massachusetts acute care hospitals are required to submit Case Mix data to the Center for Health Information and Analysis (CHIA) in order to track disease burden and associated costs statewide. Detailed information is available for each encounter, including geography (e.g., zip code, town, county, state, country), demographics (e.g., age, race, ethnicity), and costs by service (e.g., medical/ surgical, behavioral health), admission and discharge dates, diagnosis, and the facility providing patient care. Case Mix data can identify individuals who received past treatment for a substance overdose including healthcare encounters

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[76] Accessed at http://www.chiamass.gov/case-mix-data/
[77] Massachusetts acute care hospitals are required to submit Case Mix data in accordance with Regulation 114.1 CMR 17.00.

associated with detoxification, psychiatric care, and overdose based on procedures rendered or diagnoses made when these services are offered by acute-care hospitals.

Availability of data: The Center for Health Information and Analysis (CHIA) receives data quarterly. Significant work is required to clean and harmonize the data across hospitals. As a result, there is approximately a one year lag between final data submission to CHIA by acute care hospitals and receipt of the data by DPH and other approved organizations.

Limitations of the data: The Case Mix data does not include hospital services rendered to Massachusetts residents by non-Massachusetts hospitals or hospitals operated by the Veterans Administration (VA), thus reducing the observable analytic universe. Similarly, CHIA does not currently collect information from behavioral health hospitals. Demographic data included in Case Mix is not considered as accurate as those recoded on birth of death records. Consequently, the linkage of these records to other datasets may be incomplete. Furthermore, the coding of encounters for overdose or for behavioral health services is not considered fully complete. Finally and possibly most important for the Chapter 55 project is that Case Mix data are available on a Federal fiscal year. The most recent data available is through 9/30/2014 which means that any data on nonfatal overdoses, substance abuse treatment, or mental health diagnosis codes won't be captured in the final three months of the study period.

Non-Scheduled Pharmacy Claims[78] – Massachusetts All Payer Claims Database (APCD)[79]

What data are collected: The Massachusetts All Payer Claims Database (APCD) is managed by the Center for Health Information and Analysis (CHIA). The APCD contains health and pharmacy insurance claims data from the approximately 80 private health care payers, public health care payers (including Medicare and MassHealth) and publicly-supported managed care organizations and senior care organizations across the entire state of Massachusetts. The APCD insurance eligibility files include basic identifying information like full name, address, gender, date of birth, race, ethnicity, and Social Security number. Most APCD data requested from CHIA focused on pharmacy claims for non-scheduled medications.

Availability of data: The APCD is overseen by CHIA, the independent state agency responsible for collecting, cleaning, maintaining, and managing access to the data. Data are reported out once a year and each report contains all data from the previous calendar year. The newest version is available approximately 6 months after the close of the preceding calendar year.

Limitations of the data: The APCD forms the backbone or spine of the linked datasets. Its completeness and accuracy are critical to the entire effort. In recent years, CHIA has expended

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[78] Accessed at http://www.chiamass.gov/ma-apcd/
[79] CHIA has statutory authority to collect data from both public and private health care payers under Massachusetts General Laws Chapter 12C, section 10. By July 2010, Regulations 114.5 CMR 21.00 and 114.5 CMR 22.00 formally established the APCD in Massachusetts.

significant resources to link records across payers. The current APCD contains roughly 15 million unique records which is substantially above the 6.3 million residents in Massachusetts. Most of these records are single records unconnected to a full set of identifiable records. Other analyses undertaken for this project suggest that the unique records prepared for the APCD serve the purpose intended. Other known limitations of the APCD include exclusions such as Workers' Compensation, TRICARE/Veteran's Health Administration, and the Federal Employees Health Benefit Plan claims. Additionally, uninsured individuals (approximately 3% of the state's population) are not captured. Finally, healthcare services provided but paid for out of the patient's own finances, e.g., cash payment for a convenience care clinic service like a strep throat culture, are excluded because these services do not generate claims.

Department of Correction (DoC)[80] – Incarceration and Treatment[81]

What data are collected: The Department of Correction (DoC), a part of the Executive Office of Public Safety and Security, is required by statute to maintain adequate records of persons committed to the custody of the department. In addition, DoC must establish and maintain programs of research, statistics, and planning, and conduct studies relating to correctional programs and responsibilities of the Department. To achieve those goals, DoC maintains a database of individuals incarcerated in Massachusetts prisons. This database includes the substance abuse treatment received by prisoners. Identifiers like full name, gender, date of birth and Social Security numbers are also included.

Availability of data: As releases from prison are routine, these data are kept current.

Limitations of the data: DoC data includes incarcerations for those in prison and does not include data for people in jails or houses of correction (HoC). The data from DoC used in this analyses (e.g. those incarcerated during the study period and released) is only a subset of the individuals incarcerated within Massachusetts during this study period. This analysis does not included individuals that were not released during the study period, and it does not include individuals incarcerated within HoC. HoC servers a higher volume of inmates per year in comparison to DoC, primarily due to shorter sentences and those waiting trial within Hoc. Due to this limitation, using DOC data to understand the intersection between fatal opioid overdoses and the criminal justice system in Massachusetts does not provide a full picture to determine associated risks. An additional limitation arises if residents of Massachusetts are incarcerated outside of Massachusetts as that data is not captured by the DoC.

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[80] Accessed at http://www.mass.gov/eopss/agencies/doc/
[81] The collection of detailed incarceration data by DoC authorized under MGL c. 124, s. 1(j) and MGL c. 124, s. 1(k).

Appendix C: Additional Single Table Discussion

Additional Single Table Discussion: Prescription Monitoring Program (PDMP)

Key Findings: The Chapter 55 work has allowed for a robust analysis of key PDMP measures with the other linked datasets. Looking at PDMP data alone, it is notable that although there has been a seven-percent annual increase in Schedule II filled prescriptions since CY 2000; a slowing in that trend in the most recent years has been observed. This is primarily attributed to a reduction in opioid prescribing in the recent time period. It is too early to determine whether this reduction in opioid prescribing will result in fewer opioid-related overdose deaths over time. The Chapter 55 work has highlighted the alarming increase in opioid-related overdose deaths attributed to Heroin and most notably Fentanyl. How prescription opioid use/abuse impacts transitioning to these illicit drugs will be a key area of focus moving forward and the Chapter 55 linked databases will play a critical role in addressing these questions.

Other key findings identified from analyzing the PDMP dataset are that while 2 in 5 Massachusetts adults had a prescription for an opioid during the study period, only 8 percent of people who died from an opioid-related overdose had legal access to prescription opioids within a month of their death. This is critical information because without linking the datasets and reviewing medical examiner data, there is no way to estimate the extent to which diversion of prescription opioids plays a role in the opioid overdose epidemic. Additionally, the linkage with PDMP and death files highlights the significance of polysubstance use in risk of overdose death. The data show that having a concurrent prescription for opioids and benzodiazepines results in a four-fold increased risk of opioid-related death.

One additional key finding from analyzing the PDMP dataset concerns the issue of individuals obtaining controlled substance prescriptions from multiple providers (i.e., visiting different prescribers for similar or same controlled substances and having these prescriptions dispensed at different pharmacies). The occurrence of multiple provider episodes (MPEs) can be identified from analyses of the PDMP data. Linkage with the death records provides a more complete understanding of the risk that this type of activity poses in opioid-related overdose deaths. Table C.1 presents the opioid-related overdose death incident rate analysis of having different numbers of prescribers and pharmacies (0 = individuals who died were not linked to any prescription records in the PDMP). The findings clearly show the increased incidence (more than 3-fold) of having 3 or more different prescribers compared to only 1 prescriber who writes prescriptions for controlled substances. Even more striking is the apparent increase in overdose incidence when obtaining these controlled substance medications filled from three or more pharmacies compared to using only one pharmacy (18.34 versus 1.09, respectively). This apparent risk that having dispensed controlled substance prescriptions from multiple pharmacies can help inform policy moving forward.

Table C.1: Incidence of opioid overdose deaths associated with multiple provider episodes (2011-2014)				
	Prescribers			
Incidence (per 10,000 per year)	0	1	2	3+
Opioid Deaths	0.97	0.99	2.72	9.73
	Pharmacies			
Incidence (per 10,000 per year)	0	1	2	3+
Opioid Deaths	0.97	1.09	4.28	18.34

Additional Single Table Discussion: Massachusetts Ambulance Trip Record Information System (MATRIS)

Key Findings: By utilizing the linkage authorized by Chapter 55 with MATRIS and death data, EMS response was shown to be highly successful in preventing fatal overdoses. The finding that 95.8% of the patients with an opioid-related ambulance trip did not die during the study period and only 18.6% of opioid-related decedents had one or more opioid-related ambulance trips confirms that 911 response leads to a high reversal rate. Overdose campaign strategies encouraging EMS activation should continue. Of people who had an ambulance trip for a nonfatal overdose prior to their fatal overdose, 29.3% did not have an ambulance trip for their fatal overdose. This indicates that there are possible missed opportunities for interventions after the non-fatal overdose. Some examples of these interventions are: recovery coaching, treatment, and education on withdrawal and tolerance. This finding also supports the need for further promotion of the Good Samaritan Laws to encourage calling 911 for an overdose without fear of legal repercussions.

Additional Single Table Discussion: Massachusetts Cancer Registry (MCR)

Key Findings: The MCR data are included in this project so that cancer diagnosis can be controlled for in multivariate analyses. It is not intended to be analyzed separately. There is a well-known association between late stage cancer diagnosis and opioid prescribing. It was important to be able to take this into account when looking at risk of opioid death as it relates to opioid prescribing patterns.

Additional Single Table Discussion: Department of Correction (DoC)

Key Findings: Data from the Department of Correction (DoC) included information on all inmates who have been released from DoC incarceration between January 1, 2011 and December 31, 2014. The cohort included 25,209 inmates who had a total of 38,961 releases from prison. Prior studies have demonstrated that inmates face an increased risk of death, compared with the general population,

following release from prison in the United States and abroad[82,83]. Since only 2013-2014 deaths were available, inmates released only during this same time period were used to calculate the risk of death faced by those inmates after release from prison and investigate whether they had a higher risk of death after release.
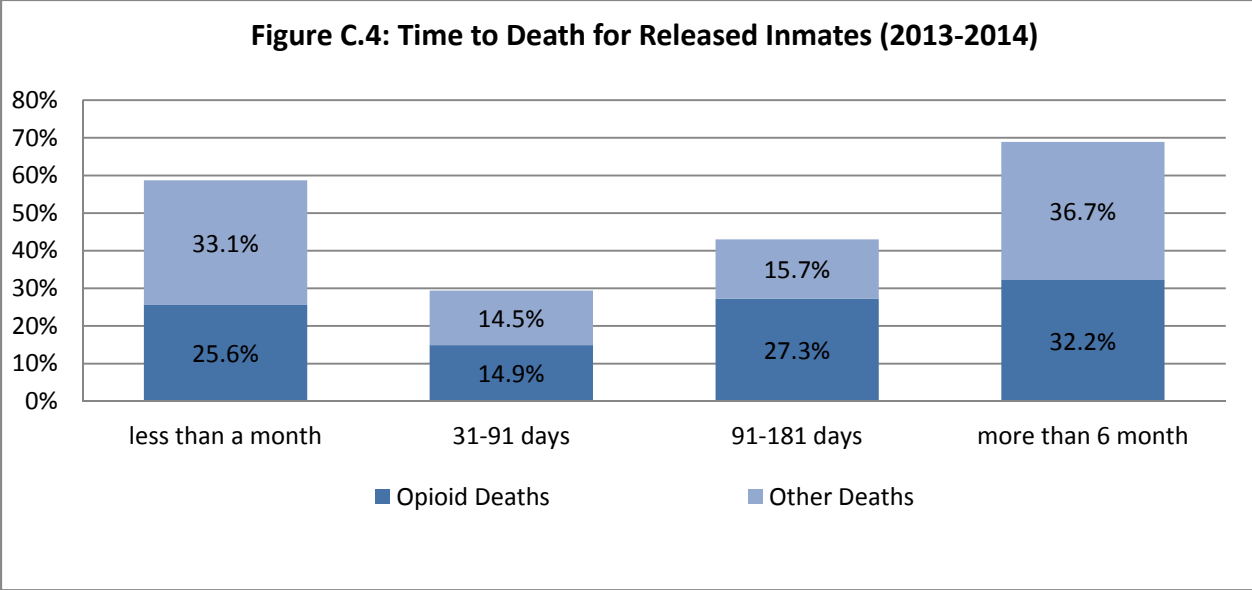
Of the 14,533 inmates released in 2013-2014, 287 died from all causes and 121 consequently died from an opioid-related overdose during the study period. In this group, 42.2% (n=121) died from an opioid-related overdose. In comparison, for the total population in the state, opioid-related deaths accounted for only 2.1% (n=2,192). The leading cause of death was injuries of all intents: 124 unintentional injuries, 16 suicides, 9 homicides and 5 injuries of undetermined intent. The second leading cause of death were ill-defined conditions-signs and symptoms (30 deaths), cancer (20 deaths), heart disease (20 deaths), and chronic liver disease (9 deaths). Looking at the leading cause of death, we see that these were mostly unintentional poisonings involving opioids. Deaths from opioid-related overdoses were more common among persons younger than 45 years, whereas deaths from cardiovascular disease and cancer were more common among those 45 years of age or older. Inmates who died from opioid-related overdoses were significantly younger than those inmates that died from other causes (35.0 vs. 47.0 years). See Table C.3.

Table C.3: Mean Age at Death with 95% Confidence Intervals (2013-2014)			
Age At Death (years)	Mean	Lower 95%	Upper 95%
All deaths	41.9	40.3	43.6
Opioid Deaths	35.0	33.2	36.7
Non-Opioid Deaths	47.0	44.7	49.2

Nearly one-quarter of released inmates in 2013-2014 who died of an opioid-related overdose died within 30 days of release. The mean time from release to death was 13 months, ranging from dying within the same month as release (or in prison) to 42 months later. See Figure C.4.

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[82] Merrall EL, Kariminia A, Binswanger IA, *et al*: Meta-analysis of drug-related deaths soon after release from prison. Addiction 105: 1545–54, 2010

[83] Binswanger IA, Stern MF, Deyo RA, *et al*: Release from prison: a high risk of death for former inmates. NEngl J Med 356:157–65, 2007
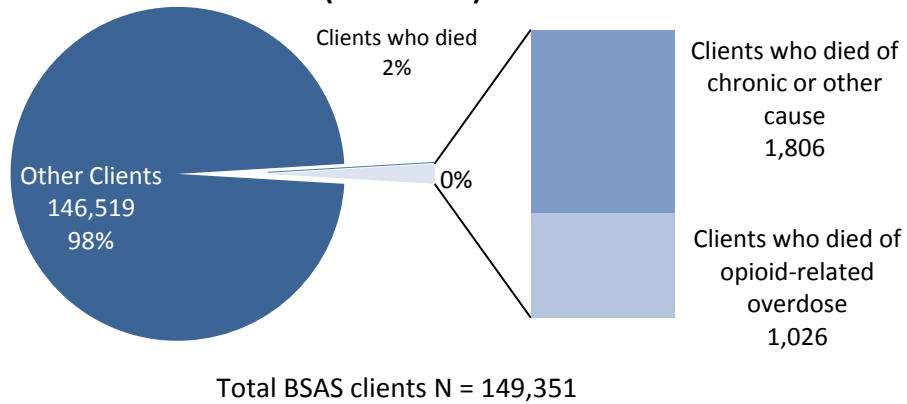
Figure C.4: Time to Death for Released Inmates (2013-2014)

Chart data:

Time period	Opioid Deaths	Other Deaths
less than a month	25.6%	33.1%
31-91 days	14.9%	14.5%
91-181 days	27.3%	15.7%
more than 6 month	32.2%	36.7%

■ Opioid Deaths   ■ Other Deaths

Additional Single Table Discussion: Bureau of Substance Abuse Services (BSAS)

Key Findings: Between 2011 and 2014, 149,351 people received addiction treatment or other recovery related services from providers that report to the BSAS. These clients were 76% white non-Hispanic, 68% male, had a median age of 37 years. Of the 149,351 people utilizing services, 87% (130,452) had at least one admission in 2011-2014; the remaining 13% utilized services in programs in which they were admitted to prior to 2011. Based on clients with admissions in the study period, 60% reported prior mental health treatment and 20% reported a prior overdose.

Additionally, 47% had at least one opioid-related admission. Similarly, people admitted to treatment reporting opioid use has increased since FY 2012. Of the clients reporting an opioid problem, the percentage that report a Heroin problem has increased over the last several years, as those that report a problem with other Opioids has simultaneously decreased. In fact, treatment admissions for non-Heroin opioids increased from 3.7% of all opioid admissions in 2000 to 21.8% in 2011 and then dropped to 9.9% in 2014. This suggests that Heroin is a major contributor in regards to the increase in treatment admissions for Opioid addiction. Although it is important to note that prescription opioids still play a role in opioid addiction and overdose. Over half of the individuals who received treatment through BSAS had a prescription for an Opioid in the PDMP during the study period.

2,832 of the 149,351 clients (1.9%) died in 2013 and 2014. Of these deaths, 1,026 were due to opioid-related overdoses (36.2%). The remaining 1,806 deaths were due to chronic disease or other causes (Figure C.6).

Figure C.6: BSAS Addiction Treatment (2011-2014) Clients and Deaths (2013-2014)

Clients who died
2%

Other Clients
146,519
98%

0%

Clients who died of chronic or other cause
1,806

Clients who died of opioid-related overdose
1,026

Total BSAS clients N = 149,351

Of all confirmed opioid-related overdose deaths in 2013-2014 (n = 2,192), 47% (n=1,026) utilized addiction treatment and recovery services in BSAS system (Figure C.7).

Figure C.7: Confirmed Opioid-Related Overdose Deaths (2013-2014) & Addiction Treatment in BSAS System (2011-2014)

No Treatment
n = 1165
(53%)
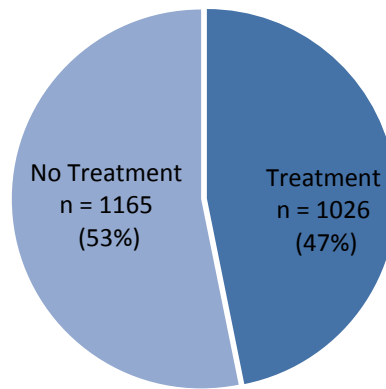
Treatment
n = 1026
(47%)

Demographics of Fatal Opioid Overdoses among BSAS clients

Among the 1,026 people who died of an opioid-related overdose and utilized addiction treatment and recovery services in the BSAS system, 85% were White non-Hispanic, 71% were male, and they had a median age of 36 at the time of death.

BSAS Treatment Population: Comparing No Death vs. Fatal Opioid overdose

BSAS clients that died of an opioid-related overdose in 2013 and 2014 utilized more acute services within the BSAS treatment system relative to other clients. Of the 1,026 people utilizing services, 91% (933) had at least one recent admission in 2011-2014; the remaining 9% utilized services in programs in which they were admitted to prior to 2011. Based on these 933 clients with recent admissions, 87% had at least one opioid-related admission, 79% reported prior mental health treatment, and 51% reported a prior overdose.

Key Take Aways

- Treatment admissions for opioid problems now account for more than half of all BSAS treatment admissions.
- Treatment admissions for non-Heroin opioids increased from 3.7% of all opioid admissions in 2000 to 21.8% in 2011 and dropped to 9.9% in 2014.
- Over half of persons who received treatment through BSAS had a prescription for an opioid during the study period.
- Nearly half of individuals who died of opioid-related overdoses had a confirmed addiction treatment history in the BSAS system.
- Of the BSAS clients who died of an opioid-related overdose, 60% utilized acute treatment services and 91% had a recent admission to any BSAS treatment or service.

Appendix D: Data Linkage

Data linkage for the Chapter 55 work was conducted by the Center for Health Information and Analysis (CHIA) in consultation with the Department of Public Health (DPH). Six levels of matches were tested between individual Chapter 55 datasets and identifiers found in the All Payer Claims Database (APCD). All matches were deterministic. A conservative approach to matching was used, so no "near" or "close" matches were considered. In other words, all successful matches had to be exact at one of six levels. The complete matching scheme is described below. The most reliable match is a "1", and so on down the chart to the least reliable, a "6".

Match Level	Identifiers To Be Matched
1	Exact match on first name, last name, Social Security number, gender, birth date, street address #1, street address #2, town of residence, and zip code.
2	Exact match on last name, Social Security number, gender, birth date, town of residence, and zip code.
3	Exact match on Social Security number, gender, and birth date.
4	Exact match on first name, last name, gender, birth date, street address #1, street address #2, town of residence, and zip code.
5	Exact match on first name, last name, gender, birth date, town of residence, and zip code.
6	Exact match on first name, last name, gender, and birth date.

CHIA processed each Chapter 55 file independent of all other files. To speed the process of the linkage work, there was no requirement for CHIA to perform data standardization or to deduplicate the data within or across files. Since data fields, collection methods, oversight, and quality vary from source to source – and even record to record – it is possible that "John Smith" got a Level 1 match in *File1* but then the same "John Smith" appeared twice in *File2*, getting a Level 2 and a Level 3 match due to algorithm rules and/or missing data. Alternatively, the various John Smiths may not be related. Without a focused deduplication effort, or a secondary weighted probabilistic match, it is impossible to know how often this might have occurred. Other tests of reliability of the matching scheme indicated that this was not a frequent occurrence. If duplicates were found within a file, each of these records was assigned the same project-specific ID (see Appendix F, de-identification). A summary of the matches across all datasets can be found in Table D.1 below.

Table D.1: Linkage rates across Chapter 55 datasets.	DEATHS 103,505	PDMP 3,475,545	BSAS 149,351	MATRIS 515,229	MCR 147,066	OCME 4,832	Case Mix 1,333,862	APCD 14,484,061	DoC 25,209
DEATHS		80508	2832	47103	20202	4781	55616	103499	565
Column %	X	2.3	1.9	9.1	13.7	98.9	4.2	0.7	2.2
Row %		77.8	2.7	45.6	19.5	4.6	53.7	>99.9	0.6
PDMP			107658	37617	122109	3504	892716	3470474	16814
Column %		X	72.1	1.1	83.0	72.3	66.9	24.0	66.7
Row %			3.1	7.3	3.5	0.7	25.7	99.9	0.48
BSAS				37811	1679	1340	55956	149252	13131
Column %			X	7.3	1.1	27.7	4.2	1.0	52.2
Row %				25.3	1.1	0.9	37.5	>99.9	8.8
MATRIS					25138	2864	221811	514866	8664
Column %				X	17.1	59.3	16.6	3.6	34.4
Row %					4.9	0.6	43.1	99.9	1.7
MCR						99	67898	146673	234
Column %					X	2.1	5.1	1.0	0.9
Row %						0.1	46.2	99.7	0.2
TOX							2332	4815	302
Column %						X	0.2	0.03	1.2
Row %							48.3	99.6	6.3
Case Mix								1333862	10298
Column %							X	9.2	40.8
Row %								100	0.7
APCD									25205
Column %								X	100
Row %									0.2
DoC									
Column %									X
Row %									

Appendix E: Data Quality and Strategies for Handling Missing Data

Data Quality Analysis:

Each data owner cleaned their data according to their usual standards. To provide some uniformity to the process of data cleaning, DPH conducted a four-step cleaning process for all analytic datasets that it held prior to delivery to the server on which all Chapter 55 datasets were stored. The first step was to screen for duplicate records; the second step was to measure the distributions of categorical and numeric variables; the third step was to assess overall data environment quality by examining various aspects of the linkages across tables; and the fourth step was to compare the linked and unlinked records for differences in demographic categories.

Step 1. Evaluation of duplicate identification values

A count of identification values was performed and compared to a count of distinct identification values for each analytic dataset. The ratio of those values indicated the level of duplication if any. The level of record duplication detected was minimal.

Step 2. Distribution of Categorical and Numeric Variables

The larger the dataset the more likely it is to contain some invalid or unknown values. For example, no age should be a negative number and it is unlikely that any age is above 110. In order to assess the quality of each variable across the datasets, it was important to quantify the frequency, percent, and cumulative percent of all valid and invalid information. High percentages of invalid data were corrected wherever possible. Assessing the quality of each numeric variable was extended to include binary variables represented by 0/1. The summary of numeric variables included quantifying the mean, maximum, and minimum values and a flag to indicate if the variable was binary. These values were calculated across all analytic datasets and applicable variables. As above, the rate of invalid data detected was minimal.

Step 3. Overall Environmental Quality

The data were evaluated for overall quality, which included determining how much overlap exists across datasets. Each unique ID was assessed for presence in each dataset and ultimately in how many and in which specific datasets the unique ID appears. The total number of ID's with a single hit as well as the total number of ID's with more than one hit were reported. Inconsistencies were evaluated based on prior knowledge of what constitutes irregular patterns among tables in which ID's appear.

Step 4. Linked Versus Unlinked Data

A six-level deterministic matching algorithm was used for matching each dataset with the APCD-Spine. For more information about this process and the percentage of matches for each dataset, please see Appendix D. Before proceeding with any analysis, it was important to understand whether there were any pronounced biases between those records that were linked to the APCD-Spine and those that were not. Individual records from original sources, such as MATRIS ambulance trip data, were excluded from the analytic environment when a match could not be

made to the CHIA spine. By comparing the demographic patterns between the linked and unlinked records, it is possible to gain a basic sense of whether the linking produced a biased dataset and thus required greater care when interpreting the results. Upon review of the datasets provided by the participating organizations, in general, there were no systemic or nonrandom patterns with two exceptions:

- 30% of all records, 25% of opioid-related records, provided by MATRIS for ambulance trips were unlinked due to missing identifiers, such as first name. This was observed to be ambulance-service-specific and therefore geographically biased, causing artificially low representation of Boston. To address this issue missing geographic information was imputed for individual rides, not patients. By imputing the geographic information, ambulance trip data could be analyzed on an aggregate basis and the 25% of opioid-related events that would have been excluded were able to be used. See the section below titled "Data Strategies" for further information about this work.
- The Department of Corrections dataset also exhibited statistically significant deviations when comparing the linked and unlinked comparison. This dataset is being examined to understand the root cause of the deviations and to determine what, if any, adjustments need to be made. The current hypothesis is that longer duration prison terms lead to shorter windows of opportunity to acquire health insurance or file a health claim and therefore appear in the Mass APCD.
- Given the large data files in use, many demographic categories showed statistically significant difference but these were not considered to be of practical importance.

Missing Data Strategy:

In any complex analytics project, data quality is a key consideration. High quality data leads to high quality results and trustworthy interpretations. Knowing the importance of the opioid threat and the criticality of providing trustworthy interpretations, the project team developed a data quality strategy to overcome known limitations in the data. These limitations are caused by imperfections in the data capturing mechanisms. For example, some fields or data elements may be optional from an operational perspective, but turned out to be critical from an analytics perspective. For this Chapter 55 Report, the team adhered to two guiding principles, identified three types of archetypal data limitations, and devised five approaches to deal with them.

Guiding Principles:

The guiding principles informed the strategy by helping to frame the problem and align the solution to the aims of the Ch. 55 Report. The first guiding principle was to be analytically rigorous and valid. This principle should allow readers to focus on results, conclusions, and interpretations rather than flaws in methodology. The second guiding principle was that a false positive was less harmful than a false negative. What this means is that the approach slightly biases toward over-reporting of critical incidents rather than under-reporting since the data capture is inherently biased towards under-capturing. To illustrate this, consider a nonfatal opioid-related overdose. The data may show 1,000 for a given time period in a given geographic area. In reality, however, if perfect data was available the real

number may be as high as 1,100. It is well known that some nonfatal overdoses are not recorded if the person is not transported by EMS or is seen in a hospital emergency department. The strategy taken here seeks to modify the data to get closer to the true value of 1,100 by using the observed values as a minimum instead of a mid-point for confidence intervals.

Common Data Limitations:

As the word implies, common data limitations are not unusual. They are seen in many datasets including the Chapter 55 datasets. They are partially-missing or conflicting data, missing columns, and missing rows. Partially-missing or conflicting data occurs when the linkage across datasets results in either one dataset having a field that another lacks (e.g., a death record for a particular individual may contain their gender while their PDMP record may not), or when two datasets have different values for the same field (e.g., a death record for a particular individual may indicate they are male while their PDMP record indicates they are female). A missing column arises when a one or more types of information are not included in a dataset. For example, education level is only recorded within the death records but not the other nine Chapter 55 datasets. A missing row arises when either a record for an individual is never recorded but service was provided or when an event occurs that is normally recorded but no record is ever made.
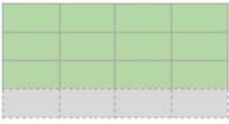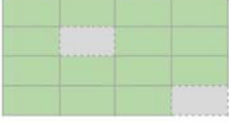
Data Strategies:

To address these limitations, five strategies were deployed. The first strategy addressed the partial and conflicting data challenge by establishing a "trust hierarchy" that created a single source of truth for each resident's demographic data based on reliability of the respective sources of that data. The second strategy addresses missing columns caused by "border leakage", a problem that arises when services are rendered outside of the State of Massachusetts and therefore not captured by any governmental agencies. To address this challenge, a border flag was created and appended to each record with a residence zip code that was near any Massachusetts state border. This variable could then be used as a covariate to help manage the risk of services missing due to geographic constraints. The third strategy dealt with missing columns due to cash payments. Since healthcare is so heavily claims and payer-oriented, when a resident chooses to pay cash instead of use their insurance for select services, those records would not be found in the data, with one notable exception which is the PDMP. By using the PDMP's cash payment indicator, researchers developed a Propensity to Use Cash Model, which helps account for utilization that may be hidden due to cash payments. To address missing rows, a SAS Macro was developed to create confidence intervals around summary statistics using a technique known as bootstrapping. This methodology incorporates uncertainty about the data to resample known data over and over again. This resampling leads to multiple simulated alternatives from which a distribution of outcomes can be derived and used to infer what the actual true value would be with perfect data. For example, data may show 50 opioid-related deaths in a given month, by using this methodology, one could observe that 90% of simulated alternative samples are below 57 opioid-related deaths and therefore establish a confidence interval that the true number of opioid-related deaths is between 50 and 57 for that specific month. The difference between observed and calculated is based on the trustworthiness of the underlying datasets. Finally, the fifth solution to missing data was to

impute missing geographic fields in MATRIS ambulance rides that were excluded from the integrated data warehouse due to a lack of matching. This approach allowed the researchers to use data for aggregate analytics despite not being able to use it to analyze individuals, thus retaining more of the information content of the MATRIS data extract. Without this imputation approach, roughly 25% of opioid-related ambulance rides would have had to have been excluded from the Chapter55 Report. See Figure E.1 for a visual depiction of these strategies.

Figure E.1: Visualization of Data Strategy

Problem Statement:

The Chapter 55 Report is drawing on data from a variety of agencies in an unprecedented level of data integration across multiple sources. As a result, this data has challenges which need to be thoughtfully addressed in order to best serve the Commonwealth.

Challenge	Description	Visual	Deployed Solutions
Partial Missing and Conflicting Data	Residents exist across multiple data sets, leading to disagreements on shared fields, e.g., zip code.	OR	1. Truth Hierarchy
Missing Rows	Data sets will be "vertically incomplete" due to limitations in data collection, restrictions on sharing, truncation, etc.		1. Imputation 2. Bootstrapping
Missing Columns	Data sets may have records with missing or invalid fields, representing missing transactions or utilization		1. Border Indicator 2. Propensity for Cash Model

Appendix F: Data Privacy and System Architecture

A determination was made at the outset of the Chapter 55 project to be able to examine all datasets in relation to each other. This required the development of a linkage or crosswalk so that individuals in one set could be located in the others, yet without revealing the identity of the matched person. The privacy concerns about holding, managing, and processing direct identifiers for so many sensitive datasets are considerable, and the processes developed to address these concerns were both thoughtful and innovative. In order to protect the privacy of the individual datasets, four approaches were used:

Encryption: All data was encrypted in transport and at rest.

De-identification: Direct identifiers were removed from each dataset prior to analyst access. The unique identifiers randomly generated for individuals were *project-specific*, meaning that no record IDs could be used to trace information back to any dataset held by any data owner now or in the future.

Securing the Server: The server on which the Chapter 55 datasets were stored was secured so the likelihood of unauthorized access was minimized to the extent possible.

Preventing Misuse by Analysts: Additional restrictions were placed on authorized access to the server on which the Chapter 55 datasets were stored in order to minimize the likelihood of intentional or unintentional misuse of the data.

Each of these approaches is described briefly below.

Encryption

Given the sensitivity of the data involved in the Chapter 55 analysis, multiple levels of encryption were used with the intent to limit data access to only authorized parties.

Whenever data was stored at rest, whether on the server or other hard media, it was protected by at least 256-bit encryption and industry-standard strong passwords. Further, whenever data needed to be transported – for example between DPH and CHIA – it was placed in an encrypted file container on physical media that used hardware-based encryption. This doubly-encrypted drive was then manually transported by a trusted and authorized team member to its destination and hand-delivered to the proper recipient, or similarly retrieved for a return trip.

De-identification

Chapter 55 datasets are not truly linked in the most commonly used sense of that word. In most cases, linkage implies a merger of datasets. For Chapter 55, a crosswalk is developed between datasets but the datasets themselves were never actually merged. This is an important distinction. By not merging data, it is argued that risk of re-identification of individuals who have information in two or more datasets is minimized. Furthermore, the unique identifiers contained in each dataset are not

found in any other project. Thus, if any breach of data or transmission protocol occurred, then the data could not be linked back to any source data file.
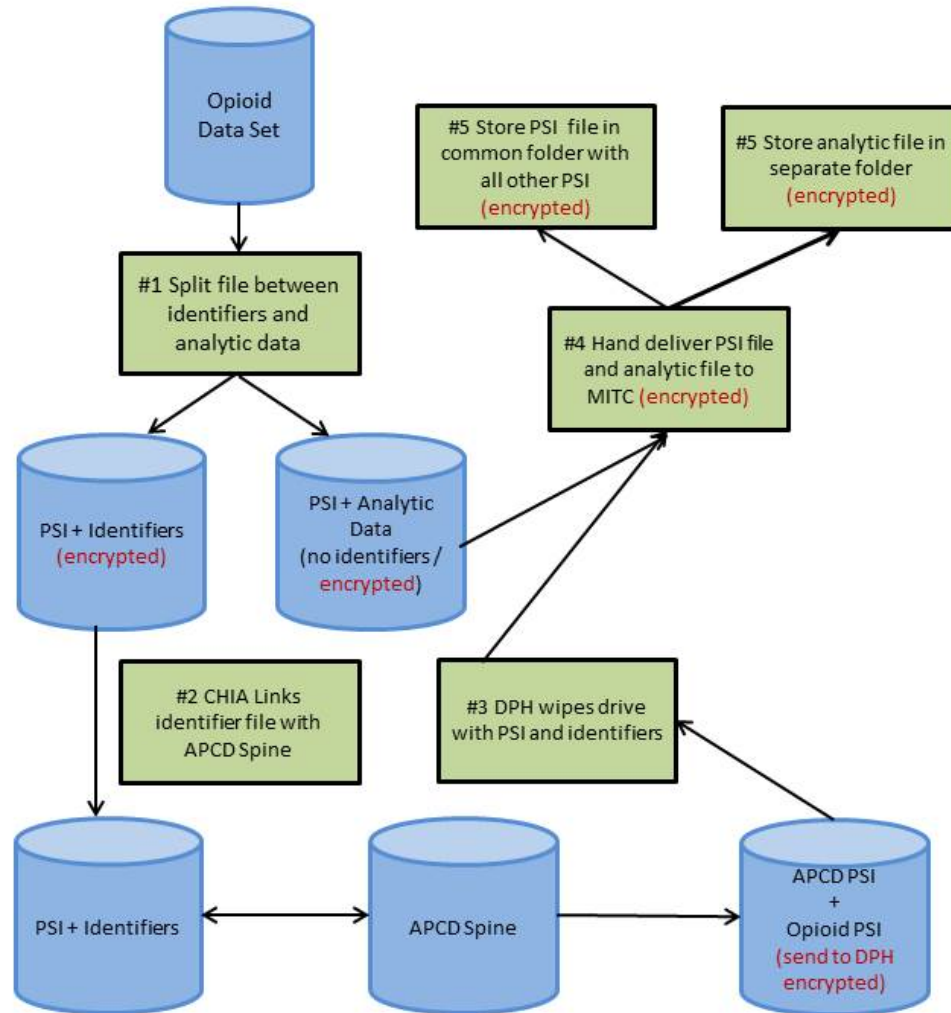
The specific steps taken to minimize of the risk to data privacy through de-identification are below. See Figure F.1 for a visual depiction of this process.

1) A pool of roughly 54 million random, non-sequential, 20-digit IDs (Random IDs or RIDs) was created at DPH. This number of values was sufficient to assign to every record of each of the constituent Chapter 55 raw datasets an ID that was unique across the entire project.

2) With RIDs affixed, each dataset was divided into two parts: direct identifiers (Identifier set) and analytic data (Analytic set). The only common information across both was the RID. The Identifier sets were hand delivered to CHIA. As noted under the Encryption section, all data was encrypted using 256-bit AES encryption with strong protection consistent with EOHHS and MassIT policy regarding password contents and length.

3) Distinct from DPH's RID-creation effort, CHIA created an extract of the All Payer Claims Database (APCD) that included only the fields to be used for the linkage scheme matching (Appendix D), plus an additional project-specific ID (PID). This PID was a random unique 20-digit number. It was in no way related to, nor derivative of, CHIA's Master Person Index (MPID) or any other persistent identifying code. This master extract-plus-PID is known as the APCD-Spine.

4) For each Identifier set, CHIA compared each record to the APCD-Spine. (For additional details on the data linkage, please see Appendix D.) Where a match was found, the PID and match level were associated with the RID from the Identifier set.

5) Upon confirmation from CHIA that an Identifier set was successfully matched to the APCD-Spine, DPH then deleted that Identifier set from its server.

6) The result set of matched PID/RID and match level were returned to DPH through the same secure mechanism as the delivery of the Identifier sets.

7) The RIDs within the returned result set were used to appropriately assign PIDs (and match confidence) to matching records in the Analytic sets. This allows the Analytic sets to be de-identified, but also connectable across datasets.

8) Because DPH had deleted the Identifier set, it was never in possession of the PID, RID and direct identifiers at the same time.

9) After assigning the PIDs to the Analytic sets, DPH securely delivered each Analytic file to the Massachusetts Information Technology Center (MITC) to be securely loaded onto the designated server.

10) In order to prevent merging of data, the project-specific identifiers and the analytic files for each Chapter 55 dataset were permanently stored in separate folders.

11) After all Chapter 55 Identifier sets have been matched and the Chapter 55 project no longer needs the APCD-Spine, CHIA will then delete it, destroying any connection between direct identifiers and PIDs at CHIA.

Figure F.1: Step by step process for transferring data securely from DPH tp CHIA to MITC

Chapter 55
Data Flow
between
DPH, CHIA,
and MITC

PSI = Project Specific Identifier

Opioid Data Set

#1 Split file between identifiers and analytic data

#5 Store PSI file in common folder with all other PSI (encrypted)

#5 Store analytic file in separate folder (encrypted)

#4 Hand deliver PSI file and analytic file to MITC (encrypted)

PSI + Identifiers (encrypted)

PSI + Analytic Data (no identifiers / encrypted)

#2 CHIA Links identifier file with APCD Spine

#3 DPH wipes drive with PSI and identifiers

PSI + Identifiers

APCD Spine

APCD PSI + Opioid PSI (send to DPH encrypted)

Securing the Server

There were three main goals in securing the SAS server:

1) Develop a clear audit process

2) Ensure proper encryption for the different needs of the users

3) Make it so that it was possible to handle more than a small number of group types in the system

These three goals were achieved in the following manner:

- The disk partition on which the Chapter 55 data was stored was encrypted using LUKS (Linux Unified Key Setup). Linux is the open-source version of the UNIX operating system and LUKS is the standard hard disk encryption method for Linux servers.

- To provide further flexibility in the design of the secure data ecosystem to the needs of the Chapter 55 project, Red Hat Enterprise Linux version 6.0 was used.

- Accounts were authenticated by LDAP, which is the MITC standard, and account creation was handled through specific (not automated) requests to the MITC Linux team.

- A unique mount point for the Chapter 55 project was created so that only group participants could gain access.

- The interface for Chapter 55 work was through the web server interface with data encrypted at rest including all individual work files.

- An audit process was implemented to record when and who was doing maintenance on/for SAS.

- All inbound requests to the server were blocked unless the requestor was on a pre-approved whitelist. The firewall restricted access to specific ports on the server. Ports were continuously monitored.

Preventing Misuse by Analysts:

To minimize the risk of misuse of Chapter 55 data by authorized users, the following processes were implemented as what has been collectively termed a **Privacy Shield**.

- Access to Chapter 55 data was only permitted using Enterprise SAS Studio software
- Only authorized users were given User IDs and passwords to access the Chapter 55 data.
- Authorized users were required to demonstrate that DPH-required privacy and confidentiality trainings were up to date.
- Only de-identified Analytic sets were accessible by analysts.
- Analysts had "read only" access to Chapter 55 datasets. Writes were not permitted.
- Analysts were not permitted to see the raw Chapter 55 Analytic data. This was accomplished by turning off the ability of authorized users to open and view raw Analytic data files.

- Analysts were not permitted to see small cell sizes. The common SAS procedure for producing counts and cross-tabulations (PROC FREQ) was altered so that it masked (by displaying asterisks) any cell count that was between 1 and 10.

- All temporary SAS work files were deleted in one of three ways. If shutdown of a process was typical, files were deleted upon shutdown. If shutdown was atypical (e.g., power outage), the system searched for orphaned work files every 15 minutes and these files were deleted. If any data query was open for more than 72 hours, then the system administrator could manually shut down a process which would delete any associated SAS work files.

- An audit process of all commands issued to SAS was implemented. Logs were checked to ensure that no analyst made any attempt to export, print, or otherwise view any Chapter 55 data.

See Figure F.2 for a visual depiction of the Chapter 55 Data Warehouse.

Figure F.2: Data analyst access to Chapter 55 datasets through a secure hardware and software Privacy Shield.

Chapter 55 Data Warehouse Overview

PSI #2 & Analytic

PSI #3 & Analytic

PSI #4 & Analytic

PSI #5 & Analytic

… additional data …

PSI #N & Analytic

PSI #1 & #2

PSI #1 & #3

PSI #1 & #4

PSI #1 & #5

… additional data …

PSI #1 & #N

PSI #1   APCD SPINE   PSI #1

PSI = Project Specific Identifier

Enterprise SAS (MITC server)

Chapter 55 Privacy Shield: Authorized users only, no write access, analysts cannot see data, automatic cell suppression, delete all temporary work files, full auditability of all data operations.

Machine 1

Machine 2

Machine 3

Machine 4

Machine 5

Machine 6

Machine 7

Machine 8

… additional machines …

Machine N

Appendix G: Legal Agreements

In order to meet the legal requirements of working with all of these protected datasets, a number of legal documents were produced. Four different types of agreements were signed.

1) Linking – This agreement between DPH and CHIA allowed for the exchange of data for the purposes of securely connecting data at the individual level across secure datasets without exposing the identity of the individual so connected.

2) Sharing – This agreement outlined the methodology and restrictions allowing for the sharing of data between different departments or agencies that were not previously sharing – or even allowed to share, outside of the Chapter 55 project. Each of the data-supplying entities was a signatory to this ISA. Specifically, signatories include: the Department of Public Health (DPH), the Department of Correction (DoC), the Office of the Chief Medical Examiner (OCME), and the Center for Health Information and Analysis (CHIA). While CHIA has previously signed the Linking agreement, they are also intended to be a provider of Analytic data from the All Payer Claims Database (APCD) and Case Mix.

3) Hosting – An agreement between DPH and MassIT specifying the hosting responsibilities and restrictions for the data infrastructure.

4) Access – An additional agreement created for *ad hoc* access to data outside of the purview of the prior three agreements. For example: If the Data Office within MassIT were to assist in a way that required analytical data access that is not covered by the 3rd agreement (which is hosting specific). This 4th agreement essentially outlines the responsibilities of being a good data steward and requires a signature for access. There would conceivably be *n* number of these agreements signed over time.

Appendix H: Cross-tabulations of Chapter 55 Datasets with Death File Demographics

Table H.1: All Deaths in Massachusetts compared to DoC population			
Characteristic	**All Deaths in MA**	**DoC**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	34 (6.0)	2473 (10.0)
25-34	1701 (1.64)	153 (27.1)	8984 (36.5)
35-44	2324 (2.25)	110 (19.5)	5998 (24.3)
45-54	6098 (5.89)	164 (29.0)	4894 (19.9)
55-64	11375 (10.99)	79 (14.0)	1896 (7.7)
65+	81072 (78.33)	25 (4.4)	399 (1.6)
Sex— no. (%)			
Male	49438 (47.8)	382 (67.6)	16140 (65.5)
Female	54067 (52.2)	183 (32.4)	8504 (34.5)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	454 (80.4)	15443 (62.7)
Black non-Hispanic	4361 (4.2)	43 (7.6)	4757 (19.3)
Asian/PI non-Hispanic	1599 (1.5)	NA	176 (0.7)
Hispanic	2822 (2.7)	56 (9.9)	3489 (14.2)
Other	703 (0.7)	10 (1.8)	778 (3.2)
Marital status — no. (%)			
Single, never married	15042 (14.5)	337 (59.7)	NA
Married or separated	36133 (34.9)	85 (15.0)	NA
Widowed	38800 (37.5)	17 (3.0)	NA
Divorced	13307 (12.9)	123 (21.8)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	445 (78.8)	NA
13+ years	34569 (33.4)	110 (19.5)	NA

Table H.2: All Deaths in Massachusetts compared to PDMP Population			
Characteristic	**All Deaths in MA**	**PDMP**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	511 (0.6)	429065 (12.6)
25-34	1701 (1.64)	1256 (1.6)	531483 (15.7)
35-44	2324 (2.25)	1807 (2.2)	497742 (14.7)
45-54	6098 (5.89)	4852 (6.0)	601398 (17.7)
55-64	11375 (10.99)	9077 (11.3)	584597 (17.2)
65+	81072 (78.33)	63005 (78.3)	750752 (22.1)
Sex— no. (%)			
Male	49438 (47.8)	36829 (45.8)	1502500 (44.3)
Female	54067 (52.2)	43679 (54.3)	1892537 (55.7)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	73881 (91.8)	NA
Black non-Hispanic	4361 (4.2)	3000 (3.7)	NA
Asian/PI non-Hispanic	1599 (1.5)	1023 (1.3)	NA
Hispanic	2822 (2.7)	2054 (2.6)	NA
Other	703 (0.7)	546 (0.7)	NA
Marital status — no. (%)			
Single, never married	15042 (14.5)	10838 (13.5)	NA
Married or separated	36133 (34.9)	28716 (35.8)	NA
Widowed	38800 (37.5)	30293 (37.6)	NA
Divorced	13307 (12.9)	10527 (13.1)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	52509 (65.2)	NA
13+ years	34569 (33.4)	26918 (33.4)	NA

Table H.3: All Deaths in Massachusetts compared to BSAS Population			
Characteristic	**All Deaths in MA**	**BSAS**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	154 (5.4)	17017 (11.6)
25-34	1701 (1.64)	608 (21.5)	48879 (33.4)
35-44	2324 (2.25)	522 (18.4)	31863 (21.7)
45-54	6098 (5.89)	835 (29.5)	29456 (20.1)
55-64	11375 (10.99)	577 (20.4)	15550 (10.6)
65+	81072 (78.33)	136 (4.8)	3754 (2.6)
Sex— no. (%)			
Male	49438 (47.8)	2049 (72.4)	99761 (68.1)
Female	54067 (52.2)	783 (27.6)	46753 (31.9)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	2335 (82.5)	110482 (75.4)
Black non-Hispanic	4361 (4.2)	171 (6.0)	10789 (7.4)
Asian/PI non-Hispanic	1599 (1.5)	12 (0.4)	1266 (0.9)
Hispanic	2822 (2.7)	245 (8.6)	18433 (12.6)
Other	703 (0.7)	69 (2.4)	4468 (3.1)
Marital status — no. (%)			
Single, never married	15042 (14.5)	1541 (54.4)	NA
Married or separated	36133 (34.9)	503 (17.8)	NA
Widowed	38800 (37.5)	91 (3.2)	NA
Divorced	13307 (12.9)	673 (23.8)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	2055 (72.6)	NA
13+ years	34569 (33.4)	738 (26.1)	NA

Table H.4: All Deaths in Massachusetts compared to MATRIS Population			
Characteristic	**All Deaths in MA**	**MATRIS**	
Age— no. (%)		**Died**	**Living**
11-24	902 (0.87)	312 (0.7)	66162 (14.1)
25-34	1701 (1.64)	925 (2.0)	63331 (13.5)
35-44	2324 (2.25)	1104 (2.3)	49788 (10.6)
45-54	6098 (5.89)	2808 (6.0)	64956 (13.9)
55-64	11375 (10.99)	5351 (11.4)	66644 (14.2)
65+	81072 (78.33)	36603 (77.7)	157168 (33.6)
Sex— no. (%)			
Male	49438 (47.8)	24462 (51.9)	214954 (45.9)
Female	54067 (52.2)	22641 (48.1)	253172 (54.1)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	42253 (89.7)	160116 (34.2)
Black non-Hispanic	4361 (4.2)	2358 (5.0)	13965 (3.0)
Asian/PI non-Hispanic	1599 (1.5)	632 (1.3)	3482 (0.7)
Hispanic	2822 (2.7)	1506 (3.2)	17671 (3.8)
Other	703 (0.7)	352 (0.8)	12592 (2.7)
Marital status — no. (%)			
Single, never married	15042 (14.5)	7553 (16.0)	NA
Married or separated	36133 (34.9)	17543 (37.4)	NA
Widowed	38800 (37.5)	15135 (32.1)	NA
Divorced	13307 (12.9)	6771 (14.4)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	30947 (65.7)	NA
13+ years	34569 (33.4)	15470 (32.8)	NA

Table H.5: All Deaths in Massachusetts compared to OCME Data			
Characteristic	**All Deaths in MA**	**OCME**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	387 (8.1)	NA
25-34	1701 (1.64)	914 (19.1)	NA
35-44	2324 (2.25)	813 (17.0)	NA
45-54	6098 (5.89)	1230 (25.7)	NA
55-64	11375 (10.99)	865 (18.1)	NA
65+	81072 (78.33)	572 (12.0)	NA
Sex— no. (%)			
Male	49438 (47.8)	3334 (69.7)	NA
Female	54067 (52.2)	1447 (30.3)	NA
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	4017 (84.0)	NA
Black non-Hispanic	4361 (4.2)	336 (7.0)	NA
Asian/PI non-Hispanic	1599 (1.5)	47 (1.0)	NA
Hispanic	2822 (2.7)	325 (6.8)	NA
Other	703 (0.7)	56 (1.2)	NA
Marital status — no. (%)			
Single, never married	15042 (14.5)	2466 (51.6)	NA
Married or separated	36133 (34.9)	982 (20.5)	NA
Widowed	38800 (37.5)	274 (5.7)	NA
Divorced	13307 (12.9)	1005 (21.0)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	3276 (68.5)	NA
13+ years	34569 (33.4)	1446 (30.2)	NA

Table H.6: All Deaths in Massachusetts compared to Cancer Population			
Characteristic	**All Deaths in MA**	**Cancer**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	34 (0.2)	960 (0.8)
25-34	1701 (1.64)	73 (0.4)	2309 (1.8)
35-44	2324 (2.25)	315 (1.6)	5026 (4.0)
45-54	6098 (5.89)	1322 (6.5)	15143 (11.9)
55-64	11375 (10.99)	3688 (18.3)	28009 (22.1)
65+	81072 (78.33)	14762 (73.1)	75417 (59.5)
Sex— no. (%)			
Male	49438 (47.8)	10554 (52.2)	57280 (45.2)
Female	54067 (52.2)	9648 (47.8)	69573 (54.8)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	18248 (90.3)	NA
Black non-Hispanic	4361 (4.2)	864 (4.3)	NA
Asian/PI non-Hispanic	1599 (1.5)	417 (2.1)	NA
Hispanic	2822 (2.7)	540 (2.7)	NA
Other	703 (0.7)	132 (0.7)	NA
Marital status — no. (%)			
Single, never married	15042 (14.5)	2372 (11.7)	NA
Married or separated	36133 (34.9)	9502 (47.0)	NA
Widowed	38800 (37.5)	5228 (25.9)	NA
Divorced	13307 (12.9)	3072 (15.2)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	12533 (62.0)	NA
13+ years	34569 (33.4)	7414 (36.7)	NA

Table H.7: All Deaths in Massachusetts compared to Case Mix Population			
Characteristic	**All Deaths in MA**	**Case Mix**	
		Died	**Living**
Age— no. (%)			
11-24	902 (0.87)	318 (0.57)	122505 (9.58)
25-34	1701 (1.64)	812 (1.46)	208860 (16.34)
35-44	2324 (2.25)	1270 (2.28)	185271 (14.49)
45-54	6098 (5.89)	3618 (6.51)	190954 (14.94)
55-64	11375 (10.99)	6590 (11.85)	206109 (16.12)
65+	81072 (78.33)	43008 (77.33)	364387 (28.51)
Sex— no. (%)			
Male	49438 (47.8)	26389 (47.45)	543108 (42.49)
Female	54067 (52.2)	29227 (52.55)	735135 (57.51)
Race or ethnic group — no. (%)			
White non-Hispanic	94012 (90.8)	49491 (88.99)	989471 (77.41)
Black non-Hispanic	4361 (4.2)	2765 (4.97)	104421 (8.17)
Asian/PI non-Hispanic	1599 (1.5)	1005 (1.81)	36667 (2.87)
Hispanic	2822 (2.7)	1986 (3.57)	113818 (8.9)
Other	703 (0.7)	369 (0.66)	33869 (2.65)
Marital status — no. (%)			
Single, never married	15042 (14.5)	8883 (15.97)	NA
Married or separated	36133 (34.9)	18038 (32.43)	NA
Widowed	38800 (37.5)	20495 (36.85)	NA
Divorced	13307 (12.9)	8072 (14.51)	NA
Education — no. (%)			
High School or Less	67362 (65.1)	37245 (66.97)	NA
13+ years	34569 (33.4)	17552 (31.56)	NA

Appendix I: Background on Addiction & the Bureau of Substance Abuse Services

Addiction Background: The etiology of addiction is dependent upon biological, psychological, and social factors. Antecedents of addiction include individual vulnerability levels, drug or object exposure, and drug or object interaction. More specifically, throughout the course of development, people encounter and accumulate specific combinations of neurobiological and psychosocial elements that can influence their behavior. Some elements increase the likelihood of addiction, whereas other factors are protective and reduce the chance of addiction (e.g., social support networks). Individuals with psychopathology (e.g., major depression, generalized anxiety disorder, or posttraumatic stress disorder) often exhibit increased prevalence of drug use disorders. Furthermore, the prevalence of psychopathology is increased among individuals who are dependent on multiple psychoactive substances (e.g., Heroin, alcohol, or cocaine)[84][85]. Various sociodemographic risk factors (e.g., relating to poverty, geography, family, and peer groups) can influence the onset and course of drug use that can similarly affect the likelihood of developing addiction.[86][87][88]

Starting in fiscal year 2012, clients receiving BSAS treatment reporting an opioid problem at the time of admission exceeded the number of clients reporting a problem with any other substance (31% in 2000 compared to 55% in 2014).[89] A significant portion of the increase was due to prescribed and illicit prescription drugs up to 2011, after which there was a drop in this category and a sharp increase in Heroin admissions.

Each expression of addiction, poses similar as well as unique consequences. Opioid Addiction, for example, poses very particular risks and adverse consequences, i.e. hypoxia (decreased oxygen to the brain), sepsis, and non-fatal/ fatal overdose. There is an elevated risk of exposure to Opioids in Massachusetts given the trends in the last decade. Opioids are a class of drugs that are naturally occurring but are also produced in a synthetic and semi-synthetic fashion. When Opioids bind to receptors in the body they can reduce the perception of pain. Opioids can produce many different side effects including: respiratory depression, drowsiness, mental confusion, and nausea. However, Opioids can produce a feeling of euphoria since they affect the brain's reward circuitry. Opioids can be prescribed for pain management, but they can also be illicitly obtained. Some examples of Opioids include: Heroin, Hydrocodone, Oxycodone, Morphine, Codeine, Tramadol and Fentanyl. Fentanyl can be prescribed for pain management, but it can also illicitly be obtained either on its own, or combined with Heroin. The potency of an Opioid as well as the combination of more than one Opioid, or the combination of an Opioid with a sedative can pose elevated risks for adverse consequences. The reason

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[84] Kessler RC, Crum RM, Warner LA, Nelson CB, Schulenberg J, Anthony JC. Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence with other psychiatric disorders in the National Comorbidity Survey. Arch Gen Psychiatry 1997;54:313–21.

[85] Tomasson K, Vaglum P. Psychopathology and alcohol consumption among treatment-seeking alcoholics: a prospective study. Addiction 1996;91:1019–30.

[86] Evans GW, Kantrowitz E. Socioeconomic status and health: the potential role of environmental risk exposure. Annual Review Public Health 2002;23:303–31.

[87] Robins LN. Vietnam veterans' rapid recovery from Heroin addiction: a fluke or normal expectation? Addiction 1993;88:1041–54

[88] Zinberg NE. Drug, set, and setting. New Haven, CT: Yale University Press, 1984.

[89] This includes both Heroin and other opioids.

for these adverse consequences has to do with fundamental components of the disease. People with addiction often experience episodes of abstinence, and relapse. When there is a period of abstinence which is followed by a relapse, a person is at enormous risk for overdose. This risk is due to tolerance and withdrawal. Tolerance and withdrawal can be explained as (1) an increased dose of a drug or object is needed to experience the same subjective effects as with a lower dose before,(2) the experience of withdrawal upon stopping use with the presence of three or more symptoms: dysphoric mood, nausea or vomiting, muscle aches, pupillary dilation, sweating, fever, diarrhea, convulsions, or tremors, and (3) the symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.[90] Tolerance among Heroin users, for example, refers to the observation that regular users require more Heroin to get the same level of intoxication experienced previously at a lower dose; withdrawal means that these users get sick when they stop using the drug and that using the drug again can make this stereotypical pattern of illness stop. The potency of a drug can also play a critical role in the relationship between abstinence, relapse, tolerance and withdrawal; if a similar dose is used, but the potency is stronger than the previous dose there is a risk for overdose and death.

Addiction treatment is intended to help individuals stop compulsive behaviors and drug and/or alcohol seeking and use by providing them with medication and behavioral coping skills as tools. Treatment can occur in a variety of settings, take many different forms, and last for different lengths of time. Because addiction is typically a chronic disorder characterized by occasional relapses, a short-term, one-time treatment is usually not sufficient. For many, treatment is a long-term process that involves multiple interventions and regular monitoring. There are a variety of evidence-based approaches to treating addiction. Treatment can include behavioral therapy (e.g. cognitive-behavioral therapy or contingency management), medications, or their combination. The setting for service delivery may be inpatient, or outpatient. A clinical recommendation for treatment depends on the individualistic needs of a client.[91]

People with Addiction often suffer from other health (e.g., depression, HIV, Hepatitis), occupational, legal, familial, financial, and social problems that should be addressed concurrently. The best programs provide a combination of therapies and other services to meet an individual's needs. Psychoactive medications, (e.g. antidepressants, anti-anxiety agents, mood stabilizers, and antipsychotic medications) may be critical for addiction treatment success for patients that have co-occurring mental disorders. Currently, the BSAS data set does not account for all these critical elements of people served in our treatment system; however there is potential to collect and analyze this information in the future.

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[90] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders: **DSM-5**. Washington, D.C: American Psychiatric Association.

[91] There are evidence-based guidelines from SAMHSA and associations like American Society of Addiction Medicine (ASAM) and American Psychological Association (APA) for particular treatment services and for particular populations. For instance, there are guidelines for clinically evaluating patients to determine what is medically necessary and determine individualistic needs. The guidelines outline standards of care for stabilizing patients with withdrawal symptoms during detoxification and there are recommendations for maintenance care. The guidelines also specify MAT dosing for detoxification purposes as well as maintenance. Often, people with severe addiction are poly-substance users and require treatment for all substances abused.

BSAS Data Collection: Massachusetts Department of Public Health's Bureau of Substance Abuse Services (BSAS) is the single state authority responsible for regulating and licensing substance abuse treatment providers throughout the Commonwealth. The Department's authority is defined under MGL Ch.111 B and E. Under this authority, the Department must ensure that treatment services are available along the continuum of care from detoxification to recovery. The Department can also engage into contracts with private providers and fund services. The Department currently licenses American Society of Addiction Medicine (ASAM) levels I – IV but only funds levels I – III. The services that fall under the funded categories range from acute detoxification to residential and outpatient-based services. In addition to licensing, regulating, and funding treatment services, BSAS funds prevention and recovery support services throughout the Commonwealth.

Appendix J: Partnerships

The Chapter 55 project brought together analysts and researchers from across government, six academic institutions, and two private consulting firms. First and foremost, the Department of Public Health would like to thank all those who participated in this effort. Without everyone's assistance, this report could not have been completed in time. The work done here has been groundbreaking and the collaboration has been extraordinary both inside and outside government institutions.

The concept of a shared, integrated, data environment, accessible by government, academic institutions and private enterprise predates both this opioid epidemic and the Chapter 55 legislation. The March 2015 report to the Legislature titled "Feasibility Proposal and Implementation Plan for a Public Health Data Warehouse" describes much of the infrastructure, data security plans, and the partnership goals that were central to the Chapter 55 work. One specific goal stated in the March 2015 report captures the approach taken by all parties. It was, "To design a technical architecture for a data warehouse that utilizes state resources efficiently while enabling secure access to public health data for internal and external users."

This goal was an acknowledgement that each type of organization (i.e., government, academic and private industry) had essential but incomplete resources and expertise relevant to completing the work undertaken in the Chapter 55 project. The Chapter 55 report, therefore, became the catalyst that motivated a collective and concerted effort towards bringing the vision of a shared, integrated, data environment to fruition. The collaborative, multi-sector, work done to date is a single instance of the vision. The Chapter 55 project represents a process that should be continued, adapted, and refined as new public health challenges and new collaborators emerge.

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• Worcester Polytechnic Institute
Private Institutions
• Boston Children's Hospital
• MITRE Corporation
• Price Waterhouse Coopers (PwC)
• SAS Analytics

Government Agencies
- Executive Office of Health and Human Services   - Executive Office of Health and Human Services, Information Technology Division   - Center for Health Information and Analysis   - MassHealth   - Executive Office of Public Safety and Security   - Department of Correction   - Office of the Chief Medical Examiner   - Massachusetts Office of Information Technology   - Enterprise Data Management ("the Data Office")   - Infrastructure Planning Group   - Office of the Chief Medical Examiner
Department of Public Health
- Commissioner's Office   - Bureau of Community Health and Prevention   - Bureau of Health Care Safety and Quality   - Office of Prescription Monitoring and Drug Control   - Emergency Medical Services   - Bureau of Family and Community Health   - Bureau of Substance Abuse Services   - Office of the Chief Legal Counsel   - Office of Office of Data Management and Outcomes Assessment