CORRELATES OF DEATH DURING AN OUTPATIENT TREATMENT

EPISODE FOR OPIOID USE DISORDER: A NATIONAL STUDY

By

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Thesis

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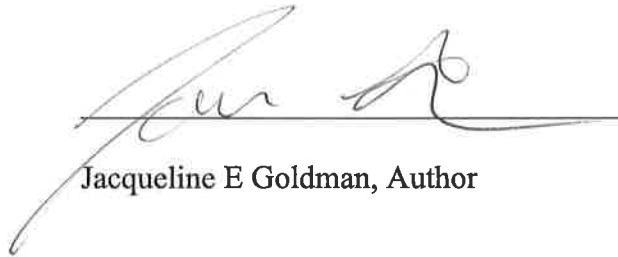Public Health at Brown University

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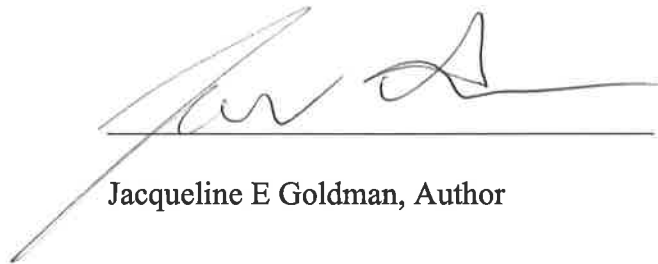
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This thesis by **_Jacqueline E Goldman_** is accepted in its present form
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Jacqueline E Goldman was born in Trumbull, Connecticut to parents Ellen and Michael Goldman. She received her Bachelor of Science from the University of Wisconsin-Madison College of Letters and Sciences in Hindi Language with honors. Following her matriculation, Jacqueline spent two years serving in AmeriCorps. For one year, she completed a number of conservation projects and in the second, she performed HIV and Hepatitis C testing and outreach in Northern New Mexico. It was there that she became engrossed in harm reduction and actively pursued the opportunity to perform research in overdose prevention during her master's. In addition to her work in school and as a research assistant during her time at Brown, Jacqueline has been become actively engaged in Rhode Island politics. It is not rare that she is at the State House advocating for reproductive rights, better drug policy, and protection of vulnerable populations in Rhode Island.

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Abstract

Background: As the burden of opioid use disorder increases in the United States, manifold federal and state initiatives have sought to increase access to treatment for opioid use disorder (OUD), which can encompass both behavioral and pharmaceutical treatment modalities. Although the evidence base for outpatient treatment for OUD—including medications for opioid use disorder—is substantial, few studies have examined the risk factors for fatality experienced during a treatment episode.

Methods: In order to evaluate correlates of death during an outpatient treatment for OUD treatment, data from the 2016 Treatment Episode Data Set-Discharges (TEDS-D) were used. To determine the correlates of mortality during an outpatient treatment episode for OUD, we constructed a pooled logistic regression model, stratified by use of medication for addiction treatment (MAT), to control for the length of treatment episodes and to identify the independent characteristics that may lead to differences in the odds of mortality experienced during treatment.

Findings: There were total of 41,781 outpatient treatment episodes for OUD that were included in our analysis, 1,656 (4%) resulted in fatality. Many factors correlated with death during treatment were similar for individuals who did and did not receive MAT. However, non-White race was only significantly associated with fatality in treatment episodes involving MAT. On the other hand, male sex and reporting intravenous drug use at admission were associated with fatality only for treatment episodes that did not involve MAT

Conclusions: In this national study of outpatient treatment episodes for OUD, we found differences in age, sex, region, drug use history, treatment setting, treatment history significantly affected the risk of death during treatment. As more people become engaged with treatment, facilities need to assess how they can deliver optimal treatment for all patients regardless of personal characteristics.

1. Introduction

The rise of opioid use over the past decade, both medical and illicit, has led to staggering rates of opioid use disorder (OUD) and fatal overdose in the United States (1,2). OUD, which accounted for 165,000 years of life lost in 1999, accounted for 830,700 years of life lost in 2016 ((3). The National Epidemiologic Survey on Alcohol and Related Conditions-III found that prevalence of OUD among adults aged 18 or over grew from 1.4% in 2002 to 2.9% in 2013 (4). As the burden of OUD has increased, so has the need for OUD treatment (5–8). According to the 2016 National Survey on Drug Use and Health, approximately 2.1 million people, about 1% of all people living in the United States 12 years or older, meet the diagnostic criteria for an OUD and could benefit from receiving psychosocial or medical treatment (9,10). However, treatment engagement for OUD is low due to factors related to lack of insurance coverage, limited access to treatment services, and stigma (11). In order to combat low treatment utilization and access, the federal government has provided significant funding towards expanding access to treatment for OUD (12–14). In addition to increases in funding for treatment centers, new federal legislation lifts some of the barriers for covering treatment costs through Medicaid and Medicare (13,15–17).

Treatment options and duration of care for OUD are diverse (18). Over the past two decades, a growing body of literature has established effective, evidence-based treatments for OUD that include both pharmaco- and behavioral (10,19,20). The use of medications for addiction treatment (MAT), such as buprenorphine and methadone, have not only been found to help patients manage their OUD symptoms, but have also led to decreases in overdose mortality (21–23). Psychosocial treatments for OUD such as counseling services and community support groups have also been shown to help people manage OUD, though they have often been found to be most effective when used in conjunction with MAT (24). Research on treatment for OUD has

largely focused on treatment success (10,23,25). Though there is no single metric that captures treatment success, abstinence from non-medical and illicit opioid use during and after treatment, treatment retention, severity of withdrawal symptoms and reduction in mortality have been used across the literature to assess treatment success (18,26). As both treatment access and burden of OUD increase, it is imperative that we understand the risk factors not only for unsuccessful treatment, but also mortality during treatment.

Although there is a significant scholarship discussing various modalities, characteristics, and other aspects of outpatient treatment of OUD (27–30), few studies have examined the risk factors for fatality during a treatment episode. According to the Treatment Episode Data Set - Discharges (TEDS-D), a dataset comprised of discharge records from publicly funded drug treatment facilities across the US, about 1% of all people admitted to a treatment facility for an OUD die in treatment; among those who are receiving outpatient treatment for opioid use disorder, that number increases to nearly 4% (31)**.** The objective of this study is to assess the sociodemographic and treatment characteristics that are be associated with experiencing a fatality during an outpatient treatment episode for OUD.

2. Methods

2.1 Study Design

In order to assess correlates of death during an outpatient treatment episode for OUD, we examined data from the TEDS-D. The TEDS-D, administered by the Substance Abuse and Mental Health Services Administration (SAMHSA), documents detailed information about sociodemographics, drug use history, and treatment received at substance use treatment centers that receive either state or federal funding (32). The data are collected at the state-level by

substance use agencies and are subsequently sent to the federal government for compilation into a nationwide dataset (33).

To capture those who received treatment for OUD in an outpatient treatment setting, data from the TEDS-D 2016 were restricted to create a final analytic sample. Specifically, the analytic sample was restricted to those treatment episodes in which the primary substance used was listed as "heroin", "non-prescription methadone" and "other opioid or synthetics". Data were further restricted to those who received treatment at an outpatient facility. Outpatient facilities were classified as either being intensive or non-intensive. Intensive facilities were defined as centers where clients received treatment, including MAT and behavioral services, for two or more hours per day for three or more days per week, and non-intensive facilities were broadly defined as ambulatory treatment services including pharmacological, individual, family and group support services (34). Restriction to outpatient treatment services was necessary as treatment completion rates and treatment duration vary extensively between outpatient and residential treatment (35). Finally, treatment episodes were removed if they were missing any values for variables that comprised the final model. The process of treatment episode exclusion can be found in **Figure 1**.

2.2 Measures

The primary outcome for this analysis was death, defined as all-cause mortality as cause of death was not specified, during a treatment episode. In TEDS-D, substance use treatment facilities can report one of seven different reasons for discharge including transfer to another facility, termination by the facility, incarceration, leaving against medical advice, other, unknown, death, and treatment completion. In this analysis, a binary outcome was created by restricting data to treatment records that resulted in treatment completion or death during treatment.

Demographic characteristics assessed included age, race, ethnicity, education level, employment status, and housing status. Race was categorized as White, Black or Other (which includes Alaskan Native, American Indian, Asian or Pacific Islander, Native Hawaiian or Pacific Islander, or people identifying as multiracial), due to sample size limitations. Housing status was reported as homeless, independent, or dependent, which SAMHSA defined as living in a supervised setting, such as a residential institution or group home (34). Additionally, we examined previous treatment admissions, intravenous drug use at admission, and the primary drug reported at treatment admission. Length of treatment was defined categorically. Time was broken into the following increments: 1-30 days, 31-45 days, 46-60 days, 61-90 days, 91-120 days, 121-180 days, 181-365 days and greater than 365 days.

2.3 Statistical Analysis

Initial exploratory data analysis revealed that there were substantial differences between treatment episodes involving MAT and those that did not. Therefore, to control for differences, we stratified the analytic sample by MAT use. Chi-square tests were performed to assess differences in demographic and treatment setting characteristics by MAT use. Descriptive statistics were created for the demographic, substance use, and treatment facility characteristics. We performed chi-square tests to measure the association of potential correlates of experiencing death during a treatment episode. In order to control for length of treatment, we constructed bivariable and multivariable pooled logistic regressions using RStudio. In instances where a time interval is provided, and time to event is not available, pooled logistic regression provides a robust estimate of the conditional odds for experiencing an outcome given a specific time interval (36). All potential correlates of death in treatment were included in the final model. For all statistics, two-sided p-values were used, and significance was considered at $p \leq 0.05$.

3. Results

There were total of 41,781 outpatient treatment episodes for OUD that were included in our analysis. Of those, 1,656 (4.0%) resulted in a fatality during treatment. Of the total sample, 29,215 (69.9%) treatment episodes did not involve MAT and 15,566 (30.1%) involved MAT. Among those who did not receive MAT, the majority of treatment episodes belonged to people between the ages of 18-34 (63.8%), males (62.0%), people who identified as White (83.7%) and non-Hispanic (90.5%). 70.1% of those not receiving MAT has experienced a previous treatment episode, 60.6% reported heroin as their primary drug of use, and 67.3% received treatment at a non-intensive facility. Similarly, a majority of treatment episodes involving MAT were among males (55.6%), people who identified as White (77.0%) and non-Hispanic (86.1%), reported a previous treatment episode (75.6%) and heroin as their primary drug of use (73.6%), and received treatment at a non-intensive facility (84.5%). Differences between treatment episodes that involved MAT and did not involve MAT can be found in **Table 1**. Compared to treatment episodes that did not involve MAT, those that involved MAT belonged to people who were older, female, have had a previous treatment episode, report heroin and intravenous drug use at admission, receive treatment at a non-intensive treatment center, and have longer treatment episodes. Additionally, treatment episodes that involved MAT were more likely to belong people who were Black or another racial background, Hispanic, and live outside the Northeast. Treatment lengths differed by treatment outcome as well as MAT use, as depicted in **Figure 2**.

Of the 29,215 outpatient treatment episodes that did not involve MAT, 454 (1.5%) resulted in a fatality. Shown in **Table 2**, bivariable analysis found that experiencing fatality during treatment among those not receiving MAT was associated with being older than 34, male,

experiencing a previous treatment episode, reporting intravenous drug and heroin use at admission, and receiving treatment in a non-intensive facility.

Of the 15,566 treatment episodes that involved MAT, 1,202 (7.7%) resulted in a fatality during treatment. Initial bivariable analysis treatment episodes involving MAT found many of the same associations with those that did not involve MAT, except that in the subset of treatment episodes that involved MAT, fatality was also associated with reporting a non-White race and Hispanic ethnicity.

Multivariable analysis of characteristics of treatment episodes and their association with mortality experienced during a treatment episode are presented in **Table 3**. Among treatment episodes not involving MAT, people age 34-54 (adjusted odds ratio [AOR],1.43; 95% confidence interval [CI], 1.17-1.76) and those older than 55 (AOR, 2.52; 95% CI,1.74-3.64) experienced higher odds of mortality compared to those 18-34. Compared to females, males experienced higher odds of fatality (AOR, 1.47; 95% CI, 1.19-1.81). Though education status was not associated with experiencing fatality during treatment, unemployment (AOR, 1.50; 95% CI, 1.14-1.96) was associated with fatality. Compared to dependent living, living independently was associated with increased odds of fatality during treatment (AOR, 1.68; 95% CI, 1.31-2.17). Receiving treatment in the Midwest resulted in higher odds of fatality (AOR, 1.93; 95% CI, 1.53-2.42) compared to receiving treatment in the Northeast, but receiving treatment in the South had a protective effect on the odds of fatality during treatment (AOR, 0.48; 95% CI, 03.5-0.66). Those who reported intravenous drug use (AOR, 1.97; 95% CI, 1.33-2.10) or heroin use (AOR, 1.52; 95% CI, 1.18-1.37) at admission experienced higher odds of fatality compared to those who did not.

Among treatment episodes involving MAT, being 34-54 (AOR 3.81; 95% CI, 3.19-4.55) or older than 55 (AOR 9.66; 95% CI, 7.91-11.81) was associated with higher odds of mortality

than those 18-34. Among those who used MAT, sex was not associated with fatality. However, compared to treatment episodes belonging to people reporting White race, Black race (AOR, 1.60 95% CI, 1.33-1.92) or another race (AOR 1.48, 95% CI 1.18-1.84) was independently associated with a higher odds of mortality. Similar to those who did not receive MAT, unemployment (AOR 1.73; 95% CI, 1.40-2.14) and independent living (AOR 1.28; 95% CI, 1.05-1.56) were associated with fatality. Compared to receiving treatment in the Northeast, receiving treatment in the Midwest (AOR 2.06; 95% CI, 1.64-2.58) and the West (AOR, 1.73; 95% CI 1.48-2.03) resulted in higher odds of treatment. Similar to those who did not receive MAT, heroin use was associated with higher odds of fatality (AOR, 1.48; 95% CI, 1.22-1.80); however, reporting intravenous drug use at admission was not associated with fatality. Additionally, experiencing a previous treatment episode was associated with an increased odds of fatality among those who were treated with MAT (AOR, 1.62; 95% CI, 1.36-1.63). Finally, compared to treatment episodes occurring in an intensive facility, receiving treatment in a non-intensive facility was associated with a nearly 7-fold increase in the odds of fatality (AOR 6.94; 95% CI, 4.77-10.10).

4. Discussion

In this national study, we found a wide array of treatment and demographic characteristics that were associated with an increased odds of fatality during outpatient treatment for opioid use disorder. For many of the correlates of death during treatment, similar associations were found for those who did and did not receive MAT. However, non-White race was only significantly associated with fatality in treatment episodes involving MAT. On the other hand, male sex and reporting intravenous drug use at admission were associated with fatality only for treatment episodes that did not involve MAT. Another important difference is the magnitude of

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the association with receiving treatment in a non-intensive treatment setting. For those receiving MAT this represented a seven-fold increase in odds, whereas it only resulted in a two-fold increase in odds of experiencing fatality for those not using MAT.

Demographic and treatment characteristics varied considerably between treatment episodes that did and did not involve MAT. For example, those receiving MAT were more likely to belong to racial and ethnic minority groups who have been found to have lower rates of treatment success across multiple studies (27,37,38). There was also significant geographic variation for those receiving MAT. Findings from this study are consistent with previous scholarship that has found that the Northeast has greater MAT capacity and engagement than other regions in the US (5,39). While these findings are in agreement with the prior literature, our finding that age was associated with both MAT use and fatality during treatment is in contrast to much of the literature. In this sample, treatment episodes involving older adults were associated with fatality across both MAT and non-MAT use, whereas previous research that has found that older age is associated with treatment success and adherence (35,40,41). However, the increased odds of fatality in treatment we observed may reflect the rise in overdose rates seen in older adults over the past few years (1,6).

Although it is important to note that MAT has been found to reduce overdose mortality and prevent relapse of OUD symptoms in many studies (22,42,43), 7% of MAT-related outpatient treatment episodes resulted in fatality during treatment, which could be attributed to a number of factors. A majority of MAT episodes took place in non-intensive treatment settings, which may offer less direct client oversight than other non-MAT intensive treatment settings (44). According to the guidelines set by the American Society of Addiction Medicine (ASAM), patients with active drug or alcohol use, as well as those with co-occurring psychological disorders, may require a higher level of care due to medical instability and lack of oversight of

care (24). Moreover, sudden cessation of MAT can result in an increased likelihood of an opioid overdose due to loss of tolerance and return to use of illicit and non-medical prescription opioids (23,45). MAT has been found to be most successful when used in conjunction with psychological interventions and social support, like family or group-based therapy, which may more likely to be found in intensive treatment settings (18,46,47). Though TEDS-D does not record details of treatment episodes, based on the definition of intensive treatment, it is likely that those receiving MAT at an intensive setting may also be receiving psychosocial therapy; however, it is unclear whether those in non-intensive settings are receiving the combination of pharmacological and behavioral therapies (29). Though there is no one-size-fits-all method of providing MAT, providers should offer combinations of pharmacological and behavioral therapies in both intensive and non-intensive treatment settings as a way to promote treatment success.

Treatment episodes belonging to people with higher risk drug use characteristics (e.g., injection drug use) were more like to experience mortality during treatment. In both the MAT and non-MAT involved treatment episodes, reporting heroin use at admission was positively associated with mortality. Intravenous drug use was associated with mortality in the non-MAT involved treatment episodes. Consistent with our findings, previous research has found that those who injected drugs were more likely to experience higher rates of fatality (48,49). This may be explained by the increased likelihood of experiencing either a fatal or non-fatal overdose after abrupt treatment discontinuation among those who inject drugs compared to other methods of drug administration (50–52). Similarly, when compared to non-medical use of a prescription opioids, heroin use is associated with increased likelihood of overdose (1,53,54). It follows that those treatment episodes belonging to people with these higher risk drug use practices would also be more likely to experience mortality during treatment. As fentanyl contamination and fentanyl

use has become more pervasive (55), there has been increased risk of fentanyl exposure during treatment episodes among who use heroin (56). Treatment facilities should offer harm reduction strategies, such as fentanyl test strips and naloxone distribution and training, that can mitigate the risk of overdose in the event of return to illicit drug use (57–59).

4.1 Limitations

This study has a number of limitations. Due to differences in how discharge forms are administered state-by-state, treatment and demographic characteristics such as insurance status, primary source of payment for treatment, days waiting to enter treatment, and attending a self-help group in the days preceding admission or following a discharge, were not captured consistently across all states and thus could not be examined in this national study. Additionally, discharges from private treatment providers were not captured in this study. Further, as TEDS-D is the compilation of survey responses from state administrative databases, there may be inconsistencies in survey administration and survey responses, especially in defining what constitutes successful treatment completion. As well, causes of death were not reported and thus there is no way to know that fatalities experienced during treatment were related to overdose or drug use. This may have led to misclassification of the outcome as well as correlates of mortality assessed. Methods to control for the association of duration of therapy and mortality were limited due to the way that time was captured in this data set (i.e., as a categorical variables). Nonetheless, we used pooled logistic regression to control for the risk of mortality across these discrete time frames. Finally, records within TEDS-D are at the treatment episode level, which means that multiple observations may come from the same individual and may have resulted in the over-estimation of the standard error. We tried to adjust for this by including previous treatment as a covariate in the model, however, we acknowledge that without being able to cluster by the individual, there will be residual bias.

5. Conclusion

In this national study of outpatient treatment episodes for OUD, we found a number of demographic and treatment setting characteristics that were associated with fatality while undergoing treatment. While many of these factors are consistent across MAT use strata, like age, region, and heroin use, there are significant racial disparities in fatality in the subset of the population whose treatment involved MAT. As treatment capacity expands, policy makers and those operating facilities need to assess ways that they can ensure optimal treatment and safety for patients regardless of their drug use behaviors and demographic characteristics. Though it may be impossible to prevent all fatalities experienced during treatment, providers should strive to have similar rates of success across demographic characteristics and drug use patterns. Datasets with more granularity around treatment setting and individual outcomes should be used to get a better understanding of other factors, such as size of facility, insurance status, comorbidities, that may contribute to fatality.

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Table 1. Comparison of demographic and treatment setting characteristics of those receiving outpatient treatment from a publicly finding facility for opioid use disorder in 2016 by MAT receipt

Characteristic	Non-MAT Total (n=29,215)	MAT Total (n=15,566)	P-value
Age			<0.001
18-34	18,643 (63.8)	6,243 (49.7)	
35-54	9,181 (31.4)	4,845 (38.5)	
55 or older	1,391 (4.8)	1,478 (11.7)	
Sex			<0.001
Female	11,091 (38.0)	5,574 (44.4)	
Male	18,124 (62.0)	6,992 (55.6)	
Race			<0.001
White	24,461 (83.7)	9,676 (77.0)	
Black	2,197 (7.5)	1,369 (10.9)	
Other	2,557 (8.7)	1,521 (12.1)	
Ethnicity			<0.001
Non-Hispanic	26,446 (90.5)	10,821 (86.1)	
Hispanic	2,769 (9.5)	1,745 (13.9)	
Region			<0.001
Northeast	12,988 (44.4)	7,608 (60.6)	
Midwest	4,471 (15.3)	1,085 (8.6)	
South	7,941 (27.2)	1,363 (10.8)	
West	3,815 (13.1)	2,510 (20.0)	
Education			0.003
Less than college	1,592 (5.4)	668 (5.3)	
Some college	6,510 (22.3)	2,617 (20.8)	
College graduate	21,113 (72.3)	9,281 (73.9)	
Employment			0.006
Full time	5,500 (18.8)	2,205 (17.5)	
Part time	2,475 (8.5)	1,111 (8.8)	
Unemployed	21,239 (72.7)	9,250 (73.6)	
Living arrangement			<0.001
Dependent living	6,344 (21.7)	1,675 (13.3)	
Homeless	1,896 (6.5)	676 (5.4)	
Independent living	20,975 (71.7)	10,215 (81.3)	

Previous treatment episode			<0.001
No	8,735 (29.9)	3,072 (24.4)	
Yes	20,480 (70.1)	9,494 (75.6)	
Previous arrests		,	
None	27,234 (93.2)	11,979 (95.3)	
One or more	1,981 (6.8)	587 (4.7)	
Intravenous drug use reported at admission			<0.001
No	14,838 (50.8)	5,797 (46.1)	
Yes	14,377 (49.2)	6,769 (53.9)	
Primary substance reported at admission			<0.001
Other opioid	11,517 (39.4)	3,309 (26.3)	
Heroin	17,698 (60.6)	9,257 (73.6)	
Number of substances reported at admission			<0.001
One	9,958 (34.1)	5,038 (40.1)	
Two	10,111 (34.6)	4,514 (35.9)	
Three	9,146 (31.3)	3,014 (24.0)	
Outpatient treatment setting			<0.001
Intensive	9,546 (32.7)	1,945 (15.5)	
Non-intensive	19,669 (67.3)	10,621 (84.5)	
Length of treatment			<0.001
1-30 days	6,059 (20.8)	1,500 (11.9)	
31-90 days	7,884 (27.0)	1,891 (15.0)	
91-120 days	3,438 (11.8)	991 (7.9)	
121-365 days	9,260 (31.7)	4,079 (32.4)	
>365 days	2,574 (8.8)	4,105 (32.7)	

Table 2. Demographic and treatment setting characteristics of outpatient treatment episodes for opioid use disorder stratified by MAT use among treatment episodes that occurred in a publicly funded treatment facility in 2016

Characteristic	non-MAT				MAT			
	Total (n=29,215)	Treatment successful (n= 28,761)	Fatality during treatment (n=454)	P-value	Total (n=15,566)	Treatment Successful (n=11,364)	Fatality during treatment (n=1,202)	P-value
Age				<0.001				<0.001
18-34	18,643 (63.8)	18,387 (63.9)	256 (56.4)		6,243 (49.7)	6,060 (53.3)	183 (15.2)	
35-54	9,181 (31.4)	9,022 (31.4)	159 (35.0)		4,845 (38.5)	4,281 (37.7)	564 (46.9)	
55 or older	1,391 (4.8)	1,352 (4.7)	39 (8.6)		1,478 (11.7)	1,023 (0.9)	455 (37.9)	
Sex				<0.001				<0.001
Female	11,091 (38.0)	10,956 (38.1)	135 (29.7)		5,574 (44.4)	5,123 (45.1)	451 (37.5)	
Male	18,124 (62.0)	17,805 (61.6)	319 (70.2)		6,992 (55.6)	6,241 (54.9)	751 (62.4)	
Race				0.335				<0.001
White	24,461 (83.7)	24,070 (83.7)	391 (86.1)		9,676 (77.0)	9,007 (79.3)	669 (55.6)	
Black	2,197 (7.5)	2,170 (7.5)	27 (5.9)		1,369 (10.9)	1,097 (9.6)	272 (22.6)	
Other	2,557 (8.7)	2,521 (8.8)	36 (7.9)		1,521 (12.1)	1,260 (11.1)	261 (21.7)	
Ethnicity				0.932				<0.001
Non-Hispanic	26,446 (90.5)	26,034 (90.5)	412 (90.7)		10,821 (86.1)	9,899 (87.1)	922 (76.7)	
Hispanic	2,769 (9.5)	2,727 (9.5)	42 (9.3)		1,745 (13.9)	1,465 (12.9)	280 (23.2)	
Region				<0.001				<0.001
Northeast	12,988 (44.4)	12,772 (44.4)	216 (47.6)		7,608 (60.6)	7,018 (61.8)	590 (49.1)	
Midwest	4,471 (15.3)	4,344 (15.1)	127 (28.0)		1,085 (8.6)	955 (8.4)	130 (10.8)	
South	7,941 (27.2)	7,884 (27.4)	57 (12.6)		1,363 (10.8)	1,276 (11.2)	87 (7.2)	
West	3,815 (13.1)	3,761 (13.1)	54 (11.9)		2,510 (20.0)	2,115 (18.6)	395 (32.9)	
Education				0.021				<0.001
Less than college	1,592 (5.4)	1,566 (5.4)	26 (5.7)		668 (5.3)	612 (5.4)	56 (4.7)	
Some college	6,510 (22.3)	6,385 (22.2)	125 (27.5)		2,617 (20.8)	2,422 (21.3)	195 (16.2)	
College graduate	21,113 (72.3)	20,810 (72.4)	303 (66.7)		9,281 (73.9)	8,330 (73.3)	951 (79.1)	
Employment				0.136				<0.001

				p-value				p-value
Full time	5,500 (18.8)	5,431 (18.9)	69 (15.2)		2,205 (17.5)	2,092 (18.4)	113 (9.4)	
Part time	2,475 (8.5)	2,435 (8.4)	41 (9.0)		1,111 (8.8)	1,056 (9.3)	55 (4.6)	
Unemployed	21,239 (72.7)	20,895 (72.7)	344 (75.8)		9,250 (73.6)	8,216 (72.3)	1,034 (86.0)	
Living arrangement				0.031				0.033
Dependent living	6,344 (21.7)	6,264 (21.8)	80 (17.6)		1,675 (13.3)	1,527 (13.4)	148 (12.3)	
Homeless	1,896 (6.5)	1,873 (6.5)	23 (5.1)		676 (5.4)	593 (5.2)	83 (6.9)	
Independent living	20,975 (71.7)	20,624 (71.7)	351 (77.3)		10,215 (81.3)	9,244 (81.3)	971 (80.7)	
Previous treatment episode				<0.001				<0.001
No	8,735 (29.9)	8,633 (30.0)	102 (22.4)		3,072 (24.4)	2,881 (25.3)	191 (15.9)	
Yes	20,480 (70.1)	20,128 (70.0)	352 (77.5)		9,494 (75.6)	8,483 (74.6)	1,011 (84.1)	
Previous arrests		,		0.206				0.166
None	27,234 (93.2)	26,818 (93.2)	416 (91.6)		11,979 (95.3)	10,823 (95.2)	1,156 (96.2)	
One or more	1,981 (6.8)	1,943 (6.7)	38 (8.4)		587 (4.7)	541 (4.7)	46 (3.8)	
Intravenous drug use reported at admission				<0.001				0.028
No	14,838 (50.8)	14,680 (51.0)	158 (34.8)		5,797 (46.1)	5,279 (46.4)	518 (43.1)	
Yes	14,377 (49.2)	14,081 (49.0)	296 (65.2)		6,769 (53.9)	6,085 (53.5)	684 (56.9)	
Primary substance reported at admission				<0.001				<0.001
Other opiate	11,517 (39.4)	11,406 (39.7)	111 (24.4)		3,309 (26.3)	3,119 (27.4)	190 (15.8)	
Heroin	17,698 (60.6)	17,355 (60.3)	343 (75.6)		9,257 (73.6)	8,245 (72.6)	1,012 (84.2)	
Number of substances reported at admission				0.012				<0.001
One	9,958 (34.1)	9,828 (34.2)	130 (28.6)		5,038 (40.1)	4,483 (39.4)	555 (46.2)	
Two	10,111 (34.6)	9,955 (34.6)	156 (34.4)		4,514 (35.9)	4,060 (35.7)	454 (37.8)	
Three	9,146 (31.3)	8,978 (31.2)	168 (37.0)		3,014 (24.0)	2,821 (24.8)	193 (16.1)	
Outpatient treatment setting				<0.001				<0.001
Intensive	9,546 (32.7)	9,442 (32.8)	104 (22.9)		1,945 (15.5)	1,915 (16.8)	30 (2.5)	
Non-intensive	19,669 (67.3)	19,319 (67.2)	350 (77.1)		10,621 (84.5)	9,449 (83.1)	1,172 (97.5)	
Length of treatment				<0.001				<0.001
1-30 days	6,059 (20.8)	5,939 (20.6)	120 (26.4)		1,500 (11.9)	1,409 (12.4)	91 (7.6)	

31-90 days	7,884 (27.0)	7,768 (27.0)	116 (25.6)	1,891 (15.0)	1,806 (15.9)	85 (7.1)
91-120 days	3,438 (11.8)	3,404 (11.8)	34 (7.4)	991 (7.9)	956 (8.4)	35 (2.9)
121-365 days	9,260 (31.7)	9,138 (31.8)	122 (26.9)	4,079 (32.4)	3,860 (34.0)	219 (18.2)
>365 days	2,574 (8.8)	2,512 (8.7)	62 (13.7)	4,105 (32.7)	3,333 (29.3)	772 (64.2)

Table 3. Associations of experiencing fatality during an outpatient treatment episode for opioid use disorder among treatment episodes occurring at a publicly funded treatment facility in 2016

Characteristic	non-MAT		MAT	
	Unadjusted Odds OR (95% CI)	Adjusted Odds OR (95% CI)	Unadjusted Odds OR (95% CI)	Adjusted Odds OR (95% CI)
Age				
18-34	Reference	Reference	Reference	Reference
35-54	1.26 (1.04-1.54)	1.43 (1.17-1.76)	4.36 (3.68-5.18)	3.81 (3.19-4.55)
55 or older	2.07 (1.47-2.91)	2.52 (1.74-3.64)	14.72 (12.25-17.70)	9.66 (7.91-11.81)
Sex				
Female	Reference	Reference	Reference	Reference
Male	1.45 (1.18-1.78)	1.47 (1.19-1.81)	1.37 (1.21-1.54)	1.05 (0.92-1.20)
Race				
White	Reference	Reference	Reference	Reference
Black	0.76 (0.52-1.13)	0.80 (0.54-0.99)	3.34 (2.86-3.89)	1.60 (1.33-1.92)
Other	0.88 (0.62-1.24)	0.95 (0.66-1.37)	2.78 (2.40-3.25)	1.48 (1.18-1.84)
Ethnicity				
Non-Hispanic	Reference	Reference	Reference	Reference
Hispanic	0.97 (0.71-1.34)	0.95 (0.66-1.37)	2.05 (1.77-2.37)	1.11 (0.89-1.38)
Region				
Northeast	Reference	Reference	Reference	Reference
Midwest	1.72 (1.38-2.15)	1.93 (1.53-2.42)	1.62 (1.32-1.98)	2.06 (1.64-2.58)
South	0.42 (0.32-0.57)	0.48 (0.35-0.66)	0.81 (0.64-1.02)	1.04 (0.80-1.34)
West	0.85 (0.62-1.14)	0.86 (0.63-1.17)	2.21 (1.94-2.54)	1.73 (1.48-2.03)
Education				
Less than college	Reference	Reference	Reference	Reference
Some college	1.18 (0.77-1.81)	1.08 (0.70-1.66)	0.88 (0.64-1.20)	0.78 (0.70-1.09)
College graduate	0.88 (0.58-1.31)	0.82 (0.54-1.23)	1.24 (0.94-1.65)	0.95 (0.70-1.29)
Employment				

Full time	Reference	Reference	Reference	Reference
Part time	1.33 (0.90-1.96)	1.40 (0.94-2.07)	0.96 (0.69-1.34)	1.00 (0.71-1.41)
Unemployed	1.30 (1.0-1.68)	1.50 (1.14-1.96)	2.33 (1.90-2.84)	1.73 (1.40-2.14)
Living arrangement				
Dependent living	Reference	Reference	Reference	Reference
Homeless	0.96 (0.60-1.53)	0.91 (0.57-1.46)	1.44 (1.08-1.92)	1.42 (1.40-1.93)
Independent living	1.33 (1.04-1.70)	1.68 (1.31-2.17)	1.08 (0.90-1.30)	1.28 (1.05-1.56)
Previous treatment episode				
No	Reference	Reference	Reference	Reference
Yes	1.48 (1.18-1.84)	1.05 (0.83-1.32)	1.80 (1.53-2.11)	1.62 (1.36-1.93)
Previous arrests				
None	Reference	Reference	Reference	Reference
One or more	1.26 (0.90-1.76)	1.14 (0.81-1.60)	0.80 (0.59-1.08)	1.17 (0.84-1.63)
Intravenous drug use reported at admission				
No	Reference	Reference	Reference	Reference
Yes	1.95 (1.61-2.37)	1.97 (1.33-2.10)	1.14 (1.02-1.29)	1.07 (0.92-1.24)
Primary substance reported at admission				
Other opioid	Reference	Reference	Reference	Reference
Heroin	2.03 (1.63-2.52)	1.52 (1.18-1.97)	2.01 (1.71-2.36)	1.48 (1.22-1.80)
Number of substances reported at admission				
One	Reference	Reference	Reference	Reference
Two	1.18 (0.94-1.50)	1.08 (0.85-1.37)	0.90 (0.79-1.03)	1.05 (0.91-1.22)
Three	1.41 (1.12-1.78)	1.22 (0.96-1.55)	0.55 (0.47-0.66)	0.89 (0.73-1.07)
Outpatient treatment setting				
Intensive	Reference	Reference	Reference	Reference
Non-intensive	1.64 (1.32-2.05)	1.83 (1.46-2.29)	7.92 (5.49-11.4)	6.94 (4.77-10.10)

Figure 1. Selection of treatment discharges in 2016 from publicly funded treatment facility that created the final analytic sample

All treatment episodes from a federally licensed treatment facility (N=1,458,045)

Treatment episodes related opioid use that resulted in either successful treatment or death (N=179,803)

Data restricted to those experiencing an outpatient treatment episode (N=51,808)

Treatment episodes removed for missing data for covariates assessed in final model
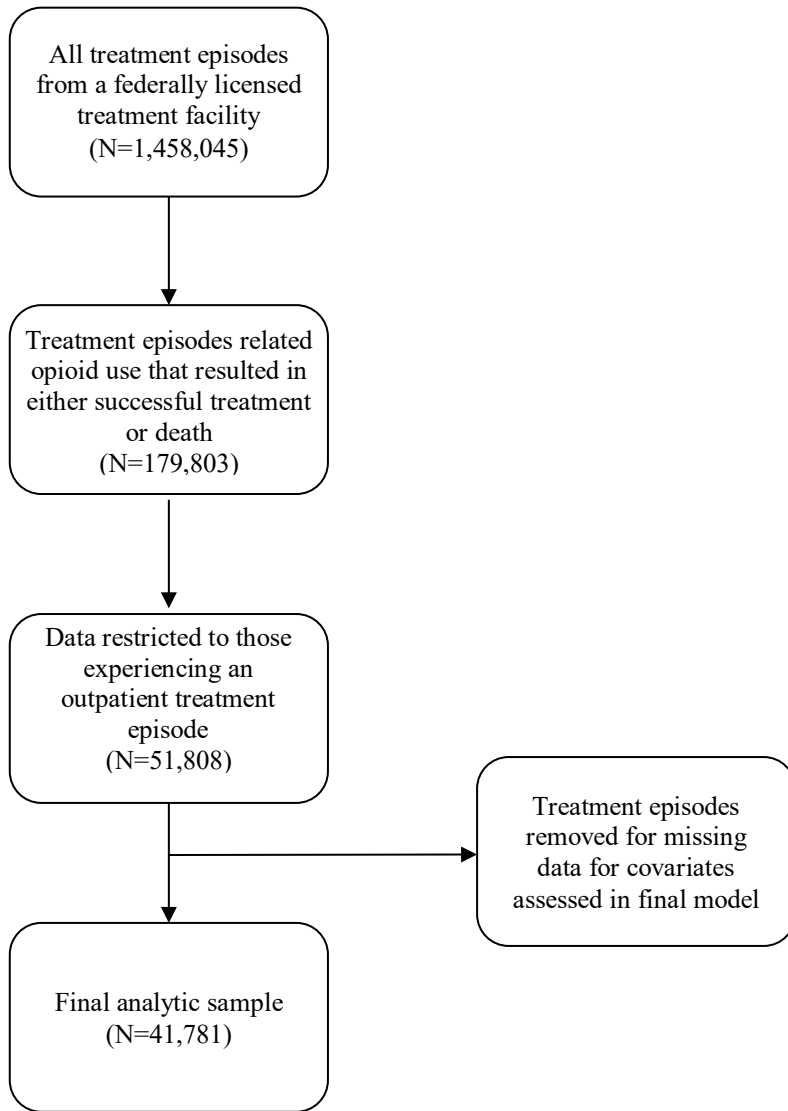
Final analytic sample (N=41,781)

Figure 2. Length of treatment episodes that took place in publicly funded treatment facilities in 2016, documented in TEDS-D, by MAT involvement and treatment episode outcome