Differences in receipt of opioid agonist treatment and time to enter treatment for opioid use disorder among specialty addiction programs in the United States, 2014-17

Justin C. Yang, Andres Roman-Urrestarazu, Carol Brayne

1 Department of Public Health & Primary Care, Institute of Public Health, University of Cambridge, Cambridge, England, United Kingdom, 2 Department and Epidemiology and Applied Clinical Research, Division of Psychiatry, Faculty of Brain Sciences, University College London, London, England, United Kingdom, 3 Department of International Health, Care and Public Health Research Institute, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands

☯ These authors contributed equally to this work.
‡ These authors are co-first authors on this work.
* jcy25@medschl.cam.ac.uk

Abstract

Background
Access to adequate treatment for opioid use disorder (OUD) has been a high priority among American policymakers. Elucidation of the sociodemographic and institutional differences associated with the use, or lack thereof, of opioid agonist therapy (OAT) provides greater clarity on who receives OAT. Timely access to care is a further consideration and bears scrutiny as well.

Methods
We draw upon data from the Treatment Episode Data Set—Admissions (TEDS-A) to analyse the relationship between sociodemographic and institutional characteristics and the receipt of opioid agonist treatments and time waiting to enter treatment.

Results
Estimates from logistic regression models highlight certain groups which show lower odds of receipt of OAT, including those in precarious housing arrangements, those unemployed or not otherwise in the labor force, and those referred by drug abuse care providers, educational institutions, employers, and the criminal justice system. Groups which showed higher odds of waiting over a week to enter treatment included those who were separated, divorced, or widowed, those working part-time, and those referred by drug abuse care providers, employers, and the criminal justice system.
Conclusion
Given the efficacy of OAT and the adverse outcomes associated with long waiting times, coordinated effort is needed to understand why these differences persist and how they may be addressed through appropriate policy responses.

Introduction
In 2010 the global burden of disease attributable to opioid dependence was 9.2 million disability-adjusted life years (DALYs) with 15.5 million individuals suffering from opioid dependence and a significantly high burden of premature mortality affecting North America and Eastern Europe [1]. In 2015, over 33,000 deaths from overdoses were recorded in the United States, nearly equal to the number of deaths from traffic accidents for the same period, with deaths from heroin alone exceeding those from homicides involving firearms [2]. The opioid epidemic in the United States has been one of the most pressing public health challenges identified by the United States Centers for Disease Control and Prevention (CDC) [2], involving both heroin use, proved to be exacerbated by socioeconomic vulnerability [3], as well as ease of accessibility and over prescription of synthetic opioids such as oxycodone and fentanyl, respectively, which appear to fuel the increasing toxicity and mortality of these substances [4]. The effects of this increasing prevalence has been an upsurge in opioid-related overdose deaths that have tripled between 1999 and 2014, with 60.9% of drug-related deaths involving an opioid [5]. Moreover, use disorders involving prescription and synthetic opioids has steadily increased; from 1997 to 2011, the number of individuals seeking treatment for opioid addiction increased by 900% [2]. Despite the urgent need for additional capacity and health system responsiveness for opioid use disorder (OUD) treatment, including the need for qualified care providers and available space in substance abuse treatment facilities, individuals with OUDs continue to face barriers to evidence-based treatment such as psychotherapy and opioid agonist treatments (OATs) which are established best practice [6, 7]. One national study in 2013 found, for instance, that lifetime cumulative probability of treatment-seeking among individuals with opioid addiction was only 42% with a median delay of 3.83 years from onset of disorder to first treatment [8]. A more recent study has also highlighted racial and ethnic differences in OAT for OUD which signal a greater need for focus to understand and overcome potential barriers to treatment to promote health equity [9]. These findings, in conjunction with research that show that opiate-dependent patients waiting for treatment are at heightened risk for mortality [10], indicate a need for greater scrutiny of barriers to treatment. In addition to barriers to treatment, the type and mode of treatment received by individuals with OUD has also been at the centre of the access barriers debate [11, 12]. OATs, such as methadone [13], are cost-effective, evidence-based treatments for OUD, especially compared against abstinence-based treatments [13, 14]. Nevertheless, OATs have historically been subject to heightened scrutiny in the United States; for example, the use of methadone is strictly regulated by the Drug Addiction Treatment Act (DATA) of 2000 and limited only to certified Opioid Treatment Programs (OTPs) [15]. Given the stringent regulatory oversight of OATs for the treatment of OUD amid the opioid crisis, the accessibility of OATs and the capacity to treat OUD has come under heightened scrutiny [16] with some calling for increased access to buprenorphine in the outpatient setting [17]. Moreover, given the urgency of non-medical use of prescription opioids (NMUPO), some attention has also been devoted to the timely receipt of care for OUD [18].
Our aim was to examine and identify patients with OUD in specialty addiction programs at risk of not receiving OAT as well as delayed entry to treatment based on: sociodemographic, and institutional characteristics. In this study, we draw upon the Treatment Episode Dataset (TEDS), an administrative dataset of annual admissions to substance abuse treatment facilities to analyse the differential use of OAT among admitted patients by patient characteristics as well as factors underlying time to enter treatment.

Material and methods

Data source

We used data from the Treatment Episode Data Set—Admissions (TEDS-A), a national administrative, fully anonymized dataset coordinated and maintained by the Center for Behavioral Health Statistics and Quality at the Substance Abuse and Mental Health Service Administration (SAMHSA), for admissions from 2014–17 [19]. TEDS-A captures information at intake on all publicly-funded admissions to public and private substance abuse treatment facilities in all 50 States, the District of Columbia, and Puerto Rico, as well as some privately-funded admissions to facilities which receive public funding, depending on whether State regulations require this information or not [19]. The unit of analysis in TEDS-A is admission, not an individual; consequently, an individual may be represented as multiple admissions in TEDS-A [19]. Nevertheless, the TEDS-A data file excludes admissions known to be transfers from one level of care to another within a single treatment episode for the same provider [19]. Collected information includes: sociodemographic characteristics of admitted patients, such as sex, age, and primary source of income, and their substance use behaviours, such as types of substances used, institutional information pertaining to the admission, and indicators of behavioural health of admitted patients [19].

Our analyses included all first-time admissions for opioid treatment where at least one of: heroin, non-prescription methadone, or other opiates was reported as the primary, secondary, or tertiary substance of abuse at time of admission (where TEDS-A only captures up to three substances of abuse at time of admission). Given our interest in the long-term treatment of OUDs with OATs vis-à-vis acute detoxification treatments, we excluded patients who were admitted only for detoxification treatment. As our outcome variables of interest were whether or not an admitted patient received opioid agonist therapy and time waiting to enter treatment, we excluded states which reported no patients receiving opioid agonist therapy (Georgia, Kansas, Montana, North Dakota, Oklahoma, Virginia, and West Virginia) or states missing data regarding time waiting to enter treatment (Connecticut, Georgia, Kentucky, Minnesota, New York, North Carolina, Oklahoma, Oregon, Rhode Island, Vermont, Virginia, Washington, and West Virginia) for each analysis, respectively, as these were likely to represent reporting errors or non-response for optional modules of TEDS-A. On This approach has been adopted elsewhere [20].

Study variables

Our primary outcome variables were whether an admitted patient received OAT, coded as a dichotomous variable by SAMHSA; and days waiting to enter treatment, coded as an ordinal categorical variable by SAMHSA (i.e. no wait, within one week, within two weeks, within one month, and more than one month). For our analysis of time waiting to enter treatment, we further dichotomized time waiting to enter treatment as either: within one week or greater than one week. This interval was selected given the clinical importance of timely OAT initiation for patients experiencing physiological dependence arising from OUD [21].
Independent variables were categorized as sociodemographic or institutional. Demographic independent variables included age, sex, ethnicity, marital status, living arrangement, and veteran status. Socioeconomic variables included years of education, employment status, primary source of income, and health insurer. Institutional characteristics included service setting at time of admission and primary source of referral. These independent variables have been well-characterized in TEDS-A and used extensively in other comparable analyses [22–27].

In addition to variables already provided in TEDS-A, namely sociodemographic characteristics of admitted patients and institutional characteristics pertaining to admission, we coded for a dichotomous variable to indicate the reported use of alcohol or benzodiazepines on admission, both of which contraindicate the use of OAT for OUD [28] and could confound our analysis of receipt of OAT.

### Statistical analysis

All statistical analyses were performed in Stata 14 [29]. For our analyses of OAT, a dichotomous outcome variable indicating whether an admitted patient received OAT, we conducted multiple maximum-likelihood logit regressions to simultaneously model how sociodemographic characteristics of admitted patients and institutional characteristics pertaining to admission were related to OAT. For our analyses of days waiting to enter treatment, a categorical outcome variable, we conducted multiple maximum-likelihood logistic regressions to simultaneously model how our predictor variables were related to a wait time of over one week to enter treatment.

### Results

Descriptive sample characteristics are presented in Tables 1 and 2. Of the 6,559,735 admissions included in the 2014–17 TEDS-A dataset, 479,322 first-time admissions for OUD treatment were included in our analysis. We note that just over one-third of admitted patients in our sample received OAT and nearly three-quarters of admitted patients were treated with no reported wait time.

### Use of opioid agonist therapy

The unadjusted and adjusted results of logistic regression of patient and institutional characteristics on receipt of OAT are shown in Table 3.

**Sociodemographic characteristics.** We found that the odds of receipt of OAT were higher in all age groups relative to the reference group (aged 18–20) with the highest odds of receipt of OAT reported by those in age groups 45–49, 50–54, and 55+. Women showed very slightly higher odds of receipt of OAT compared to men. Native Americans showed higher odds of receipt of OAT compared to White Americans while those reporting Other as ethnicity showed lower odds. Compared to those reporting never having married, all other groups showed lower odds of receipt of OAT. Those reporting a dependent or homeless living situation showed lower odds of receipt of OAT compared to those who reported an independent living situation. There was no statistically significant difference in the odds of receipt of OAT between veterans and non-veterans. Compared to those working full-time, those who were unemployed or otherwise not in the labor force exhibited lower odds of receipt of OAT. Those insured by either Medicaid or Medicare showed higher odds of receipt of OAT.

**Institutional characteristics.** Those admitted to short-term care facilities or an ambulatory care setting showed statistically significantly higher odds of receipt of OAT compared to those admitted to the hospital setting. All primary sources of referral showed lower odds of receipt of OAT compared with the reference group of individually referred (including self-referred) patients.
Table 1. Characteristics of admitted patients either receiving or not receiving opioid agonist therapy for opioid use disorder, 2014–17.

| Characteristic                          | Medication-Assisted Opioid Therapy | Total |
|----------------------------------------|-----------------------------------|-------|
|                                        | No | %        | Yes | %        |       |
| Age                                    |    |          |     |          |       |
| 18–20                                  | 15,850 | 82.1 | 3,446 | 17.9 | 19,296 |
| 21–24                                  | 49,224 | 75 | 16,399 | 25 | 65,623 |
| 25–29                                  | 76,169 | 69.2 | 33,939 | 30.8 | 110,108 |
| 30–34                                  | 56,587 | 65.4 | 29,960 | 34.6 | 86,547 |
| 35–39                                  | 35,327 | 62.5 | 21,199 | 37.5 | 56,526 |
| 40–44                                  | 20,810 | 58.1 | 14,998 | 41.9 | 35,808 |
| 45–49                                  | 16,546 | 51 | 15,915 | 49 | 32,461 |
| 50–54                                  | 12,848 | 45.9 | 15,165 | 54.1 | 28,013 |
| 55+                                    | 13,449 | 41.6 | 18,881 | 58.4 | 32,330 |
| Total                                  | 296,810 | 63.6 | 169,902 | 36.4 | 466,712 |
| Sex                                    |    |          |     |          |       |
| Male                                   | 171,350 | 64.1 | 95,763 | 35.9 | 267,113 |
| Female                                 | 125,407 | 62.9 | 74,121 | 37.1 | 199,528 |
| Total                                  | 296,757 | 63.6 | 169,884 | 36.4 | 466,641 |
| Ethnicity                              |    |          |     |          |       |
| White                                  | 232,348 | 67.1 | 113,809 | 32.9 | 346,157 |
| Black or African American              | 31,093 | 51.3 | 29,525 | 48.7 | 60,618 |
| Asian or Pacific Islander              | 2,545 | 59.1 | 1,761 | 40.9 | 4,306 |
| Native American                        | 5,408 | 72.7 | 2,032 | 27.3 | 7,440 |
| Other                                  | 19,613 | 57.1 | 14,753 | 42.9 | 34,366 |
| Total                                  | 291,007 | 64.3 | 161,880 | 35.7 | 452,887 |
| Marital Status                         |    |          |     |          |       |
| Never Married                          | 161,768 | 66.2 | 82,587 | 33.8 | 244,355 |
| Married                                | 35,931 | 64.1 | 20,163 | 35.9 | 56,094 |
| Separated                              | 14,626 | 72.5 | 5,556 | 27.5 | 20,182 |
| Divorced or Widowed                    | 29,048 | 68.3 | 13,510 | 31.7 | 42,558 |
| Total                                  | 241,373 | 66.5 | 121,816 | 33.5 | 363,189 |
| Living Arrangement                     |    |          |     |          |       |
| Independent                            | 202,019 | 60.7 | 130,699 | 39.3 | 332,718 |
| Dependent                              | 55,161 | 73.7 | 19,643 | 26.3 | 74,804 |
| Homeless                               | 29,199 | 74.6 | 9,961 | 25.4 | 39,160 |
| Total                                  | 286,379 | 64.1 | 160,303 | 35.9 | 446,682 |
| Veteran Status                         |    |          |     |          |       |
| No                                     | 264,993 | 63.5 | 152,523 | 36.5 | 417,516 |
| Yes                                    | 5,934 | 63.4 | 3,430 | 36.6 | 9,364 |
| Total                                  | 270,927 | 63.5 | 155,953 | 36.5 | 426,880 |
| Education                              |    |          |     |          |       |
| <8 Years                               | 13,790 | 64.6 | 7,567 | 35.4 | 21,357 |
| 9–11 Years                             | 60,295 | 63.9 | 34,096 | 36.1 | 94,391 |
| 12 Years                               | 140,093 | 64 | 78,825 | 36 | 218,918 |
| 13–15 Years                            | 57,293 | 71.6 | 22,716 | 28.4 | 80,009 |
| 16+ Years                              | 15,655 | 62.8 | 9,285 | 37.2 | 24,940 |
| Total                                  | 287,126 | 65.3 | 152,489 | 34.7 | 439,615 |

(Continued)
Table 1. (Continued)

| Characteristic                        | Medication-Assisted Opioid Therapy |
|---------------------------------------|------------------------------------|
|                                       | No | %     | Yes | %     |
|                                       | No. | %     | No. | %     |
| Full-Time                             | 43,621 | 61.6 | 27,175 | 38.4 |
| Part-Time                             | 21,843 | 62.1 | 13,352 | 37.9 |
| Unemployed                            | 132,192 | 69.8 | 57,303 | 30.2 |
| Not in Labor Force                    | 94,569 | 61    | 60,381 | 39   |
| Total                                 | 292,225 | 64.9 | 158,211 | 35.1 |

Source Of Income/Support

| Wages/Salary                          | 46,554 | 62.1 | 28,460 | 37.9 |
| Public Assistance                     | 12,312 | 45.9 | 14,490 | 54.1 |
| Retirement/Pension or Disability     | 9,815  | 46.3 | 11,387 | 53.7 |
| Other                                | 27,174 | 60.9 | 17,427 | 39.1 |
| None                                 | 68,862 | 79.9 | 17,310 | 20.1 |
| Total                                 | 164,717 | 64.9 | 89,074 | 35.1 |

Health Insurance

| Private                               | 11,591 | 74.8 | 3,896 | 25.2 |
| Medicaid                              | 53,938 | 45.6 | 64,462 | 54.4 |
| Medicare or Other                     | 12,074 | 68.4 | 5,588 | 31.6 |
| Uninsured                             | 53,543 | 82.9 | 11,060 | 17.1 |
| Total                                 | 131,146 | 60.7 | 85,006 | 39.3 |

Service Setting At Admission

| Hospital                              | 1,735  | 93.1 | 129 | 6.9 |
| Short-Term                            | 51,556 | 92.6 | 4,105 | 7.4 |
| Long-Term                             | 30,844 | 93   | 2,329 | 7   |
| Ambulatory, Intensive Outpatient      | 54,297 | 88   | 7,387 | 12 |
| Ambulatory, Non-Intensive Outpatient  | 158,361 | 50.4 | 155,865 | 49.6 |
| Total                                 | 296,793 | 63.6 | 169,815 | 36.4 |

Principal Source Of Referral

| Individual (including Self-Referral) | 110,118 | 45.8 | 130,248 | 54.2 |
| Alcohol/Drug Abuse Care Provider     | 22,933 | 72.4 | 8,750 | 27.6 |
| Other Health Care Provider           | 24,310 | 76.4 | 7,513 | 23.6 |
| Educational Institution              | 209    | 86.7 | 32    | 13.3 |
| Employer                             | 1,167  | 92.2 | 99    | 7.8 |
| Other Community Referral             | 34,836 | 68.7 | 15,864 | 31.3 |
| Court/Criminal Justice Referral/DUI  | 96,218 | 93.8 | 6,356 | 6.2 |
| Total                                 | 289,791 | 63.2 | 168,862 | 36.8 |

Alcohol or Benzodiazepines Reported at Admission

| No                                   | 214,354 | 58.4 | 152,996 | 41.6 |
| Yes                                  | 82,456  | 83   | 16,906 | 17   |
| Total                                | 296,810 | 63.6 | 169,902 | 36.4 |

https://doi.org/10.1371/journal.pone.0226349.t001

Days waiting to enter treatment

The unadjusted and adjusted results of logistic regression of patient and institutional characteristics on time waiting to enter treatment (i.e. one week or less compared to more than one week) are shown in Table 4.
Table 2. Characteristics of admitted patients by days waiting to enter treatment for opioid use disorder, 2014–17.

| Characteristic | Days Waiting to Enter Treatment |
|----------------|---------------------------------|
|                | No wait | Within one week | Within two weeks | Within one month | More than one month | Total |
|                | No. %   | No. %           | No. %            | No. %            | No. %               | No. % |
| Age            |         |                 |                  |                  |                     |       |
| 18–20          | 8,236   | 68.2            | 2,551            | 21.1             | 627                 | 5.2   |
| 21–24          | 29,803  | 70.7            | 8,067            | 19.1             | 2,119               | 5     |
| 25–29          | 53,751  | 72.9            | 12,964           | 17.6             | 3,422               | 4.6   |
| 30–34          | 42,980  | 73.7            | 10,138           | 17.4             | 2,478               | 4.2   |
| 35–39          | 28,480  | 74.5            | 6,355            | 16.6             | 1,655               | 4.3   |
| 40–44          | 18,507  | 75.7            | 4,103            | 16.8             | 893                 | 3.7   |
| 45–49          | 18,219  | 78.1            | 3,509            | 15.1             | 185                 | 1.4   |
| 50–54          | 16,535  | 79.8            | 3,000            | 14.5             | 586                 | 2.8   |
| 55+            | 20,012  | 81.9            | 3,097            | 12.7             | 637                 | 2.6   |
| Total          | 236,532 | 74.5            | 53,784           | 16.9             | 13,232              | 4.2   |
|                |         |                 |                  |                  |                     |       |
| Sex            |         |                 |                  |                  |                     |       |
| Male           | 134,703 | 74.4            | 30,936           | 17.1             | 7,460               | 4.1   |
| Female         | 101,799 | 74.7            | 22,840           | 16.8             | 5,767               | 3.9   |
| Total          | 236,502 | 74.5            | 53,776           | 17.3             | 13,227              | 4.3   |
| Race           |         |                 |                  |                  |                     |       |
| White          | 166,028 | 72.6            | 41,247           | 18.3             | 10,417              | 4.6   |
| Black or African American | 38,506 | 79.7 | 7,103 | 14.7 | 1,461 | 3 |
| Asian or Pacific Islander | 2,445 | 73.9 | 603 | 18.2 | 107 | 3.2 |
| Native American | 2,508 | 74.6 | 507 | 15.1 | 148 | 4.4 |
| Other          | 16,070  | 75.7            | 3,225            | 15.2             | 902                 | 4.2   |
| Total          | 225,557 | 74.5            | 52,685           | 17.3             | 13,035              | 4.3   |
| Marital Status |         |                 |                  |                  |                     |       |
| Never Married  | 115,434 | 71.2            | 32,037           | 19.8             | 7,498               | 4.6   |
| Married        | 22,734  | 70.5            | 6,420            | 19.9             | 1,461               | 4.2   |
| Separated      | 8,620   | 70              | 2,361            | 19.2             | 658                 | 5.3   |
| Divorced or Widowed | 18,364 | 69.3 | 5,399 | 20.4 | 1,383 | 5.2 |
| Total          | 165,152 | 70.8            | 46,217           | 19.8             | 11,102              | 4.8   |
| Living Arrangement |     |                 |                  |                  |                     |       |
| Independent    | 158,464 | 73.8            | 38,170           | 17.8             | 9,192               | 4.3   |
| Dependent      | 44,128  | 74.8            | 9,312            | 15.8             | 2,445               | 4.1   |
| Homeless       | 20,257  | 71.5            | 5,114            | 18.1             | 1,393               | 4.9   |
| Total          | 222,849 | 73.8            | 52,596           | 17.4             | 13,030              | 4.3   |
| Veteran Status |         |                 |                  |                  |                     |       |
| No             | 213,260 | 73.8            | 50,307           | 17.4             | 12,538              | 4.3   |
| Yes            | 4,869   | 71.6            | 1,317            | 19.4             | 278                 | 4.1   |
| Total          | 218,129 | 73.7            | 51,624           | 17.5             | 12,816              | 4.3   |
| Education      |         |                 |                  |                  |                     |       |
| <8 Years       | 9,325   | 73.8            | 2,256            | 17.9             | 496                 | 3.9   |
| 9–11 Years     | 48,243  | 74.2            | 10,996           | 16.9             | 2,730               | 4.2   |
| 12 Years       | 112,701 | 73.5            | 27,332           | 17.8             | 6,603               | 4.3   |
| 13–15 Years    | 32,722  | 69.3            | 9,233            | 19.6             | 2,546               | 5.4   |
| 16+ Years      | 12,214  | 76.3            | 2,536            | 15.8             | 660                 | 4.1   |
| Total          | 215,205 | 73.1            | 52,353           | 17.8             | 13,035              | 4.4   |

(Continued)
Table 2. (Continued)

| Characteristic | Days Waiting to Enter Treatment |
|----------------|---------------------------------|
|                | No wait | Within one week | Within two weeks | Within one month | More than one month | Total |
|                | No.     | %                | No.               | %                | No.               | %        | No.         | %  |
| Employment Status |        |                  |                   |                   |                   |          |              |    |
| Full-Time       | 31,458  | 72.4             | 8,137             | 18.7             | 1,964             | 4.5       | 1,375       | 3.2 |
| Part-Time       | 16,544  | 72.3             | 4,074             | 17.8             | 1,174             | 5.1       | 788         | 3.4 |
| Unemployed      | 89,931  | 72.2             | 22,929            | 18.4             | 5,956             | 4.8       | 4,471       | 3.6 |
| Not in Labor Force | 85,056 | 76.2             | 17,899            | 16.0             | 4,017             | 3.6       | 3,378       | 3.1 |
| Total           | 222,989 | 73.6             | 53,039            | 17.5             | 13,111            | 4.3       | 10,012      | 3.3 |
| Source Of Income/Support |        |                  |                   |                   |                   |          |              |    |
| Wages/Salary    | 38,861  | 71.4             | 10,421            | 19.1             | 2,612             | 4.8       | 1,894       | 3.5 |
| Public Assistance | 15,807  | 77.7             | 3,352             | 16.3             | 666               | 3.2       | 529         | 3.2 |
| Retirement/Pension or Disability | 13,882 | 76.7             | 2,996             | 16.6             | 577               | 3.2       | 475         | 2.6 |
| Other           | 17,382  | 74.1             | 4,498             | 19.2             | 820               | 3.5       | 582         | 3.5 |
| None            | 42,976  | 66.3             | 14,550            | 22.5             | 3,320             | 5.1       | 2,930       | 4.5 |
| Total           | 128,908 | 71.1             | 35,817            | 19.8             | 7,995             | 4.4       | 6,410       | 3.5 |
| Health Insurance |        |                  |                   |                   |                   |          |              |    |
| Private         | 8,586   | 61.1             | 4,105             | 29.2             | 735               | 5.2       | 485         | 3.5 |
| Medicaid        | 85,714  | 80.1             | 15,646            | 14.6             | 2,404             | 2.6       | 2,234       | 2.1 |
| Medicare or Other | 10,251  | 73.8             | 2,445             | 17.6             | 552               | 4.0       | 466         | 3.4 |
| Uninsured       | 40,396  | 69.2             | 12,134            | 20.8             | 2,861             | 4.9       | 2,313       | 4.0 |
| Total           | 144,947 | 71.1             | 34,330            | 17.8             | 6,952             | 3.6       | 5,498       | 3.8 |
| Service Setting At Admission |        |                  |                   |                   |                   |          |              |    |
| Hospital        | 85      | 26.6             | 122               | 38.2             | 42                | 13.2      | 50          | 15.7 |
| Short-Term      | 22,173  | 64.7             | 7,710             | 22.5             | 2,234             | 6.5       | 1,717       | 5.4 |
| Long-Term       | 14,419  | 73.6             | 5,772             | 23.6             | 1,634             | 6.7       | 1,760       | 7.2 |
| Ambulatory, Intensive Outpatient | 33,292 | 68.2             | 11,170            | 22.9             | 2,307             | 4.7       | 1,583       | 3.2 |
| Ambulatory, Non-Intensive Outpatient | 166,537 | 79.5             | 29,007            | 13.8             | 7,014             | 3.3       | 5,035       | 2.4 |
| Total           | 236,506 | 74.5             | 53,781            | 16.9             | 13,231            | 4.2       | 10,145      | 3.2 |
| Principal Source Of Referral |        |                  |                   |                   |                   |          |              |    |
| Individual (including Self-Referral) | 132,257 | 78.3             | 25,967            | 15.4             | 5,390             | 3.2       | 3,830       | 2.3 |
| Alcohol/Drug Abuse Care Provider | 14,981 | 65.5             | 5,328             | 23.3             | 1,411             | 6.2       | 977         | 4.3 |
| Other Health Care Provider | 11,028 | 70.0             | 3,248             | 20.6             | 729               | 4.6       | 532         | 4.5 |
| Educational Institution | 87 | 68.5             | 26                | 20.5             | 7                 | 5.5       | 4           | 3.1 |
| Employer        | 266     | 65.8             | 94                | 23.3             | 27                | 6.7       | 17          | 4.2 |
| Other Community Referral | 26,036 | 75.1             | 5,837             | 16.8             | 1,464             | 4.2       | 1,046       | 3.0 |
| Court/Criminal Justice Referral/DUI | 47,123 | 68.3             | 12,744            | 18.5             | 4,001             | 5.8       | 3,570       | 5.2 |
| Total           | 231,778 | 74.4             | 53,244            | 17.1             | 13,029            | 4.2       | 9,976       | 3.2 |
| Alcohol or Benzodiazepines Reported at Admission |        |                  |                   |                   |                   |          |              |    |
| Substance Not Reported | 199,639 | 76.2             | 41,930            | 16.0             | 9,856             | 3.8       | 7,641       | 2.9 |
| Substance Reported | 36,893  | 66.5             | 11,854            | 21.4             | 3,376             | 6.1       | 2,504       | 4.5 |
| Total           | 236,532 | 74.5             | 53,784            | 16.9             | 13,232            | 4.2       | 10,145      | 3.2 |

Sociodemographic characteristics. Only those aged 21–24 showed higher odds of waiting over a week to enter treatment compared to the reference group of those aged 18–20. No statistically significant difference in the odds of waiting over a week were found between men and women. Black or African Americans showed lower odds of waiting over a week to enter.
Table 3. Logistic regression estimates for receipt of opioid agonist therapy for opioid use disorder among admitted patients, 2014–17.

| Characteristic                      | Unadjusted OR | 95% CI      | Adjusted AOR | 95% CI      |
|-------------------------------------|---------------|-------------|--------------|-------------|
| **Age**                             |               |             |              |             |
| 18–20                               | 1             | 1           | 1            | 1           |
| 21–24                               | 1.532         | (1.471–1.596)| 1.527        | (1.377–1.693)|
| 25–29                               | 2.049         | (1.971–2.131)| 1.780        | (1.612–1.966)|
| 30–34                               | 2.435         | (2.341–2.533)| 2.083        | (1.884–2.304)|
| 35–39                               | 2.760         | (2.650–2.874)| 2.365        | (2.130–2.625)|
| 40–44                               | 3.315         | (3.177–3.459)| 2.706        | (2.426–3.018)|
| 45–49                               | 4.424         | (4.239–4.618)| 3.023        | (2.706–3.378)|
| 50–54                               | 5.429         | (5.197–5.672)| 3.024        | (2.698–3.390)|
| 55+                                 | 6.457         | (6.186–6.741)| 3.444        | (3.068–3.865)|
| **Female**                          | 1.058         | (1.045–1.070)| 1.113        | (1.076–1.151)|
| **Ethnicity**                       |               |             |              |             |
| White                               | 1             | 1           | 1            | 1           |
| Black or African American           | 1.939         | (1.905–1.973)| 0.987        | (0.941–1.035)|
| Asian or Pacific Islander           | 1.413         | (1.329–1.502)| 0.882        | (0.733–1.060)|
| Native American                     | 0.767         | (0.729–0.808)| 1.355        | (1.122–1.637)|
| Other                               | 1.536         | (1.501–1.571)| 0.822        | (0.734–0.920)|
| **Marital Status**                  |               |             |              |             |
| Never Married                       | 1             | 1           | 1            | 1           |
| Married                             | 1.099         | (1.078–1.120)| 0.938        | (0.896–0.982)|
| Separated                           | 0.744         | (0.721–0.768)| 0.835        | (0.778–0.897)|
| Divorced or Widowed                 | 0.911         | (0.891–0.931)| 0.813        | (0.772–0.857)|
| **Living Arrangement**             |               |             |              |             |
| Independent                         | 1             | 1           | 1            | 1           |
| Dependent                           | 0.550         | (0.541–0.560)| 0.706        | (0.670–0.745)|
| Homeless                            | 0.527         | (0.515–0.540)| 0.731        | (0.681–0.784)|
| Veteran Status                      | 1.004         | (0.962–1.048)| 1.100        | (0.988–1.224)|
| **Years of Education**             |               |             |              |             |
| <8 Years                            | 1             | 1           | 1            | 1           |
| 9–11 Years                          | 1.031         | (0.999–1.063)| 1.185        | (1.099–1.278)|
| 12 Years                            | 1.025         | (0.996–1.056)| 1.061        | (0.989–1.138)|
| 13–15 Years                         | 0.723         | (0.700–0.746)| 0.956        | (0.882–1.035)|
| 16+ Years                           | 1.081         | (1.041–1.123)| 0.905        | (0.826–0.992)|
| **Employment Status**              |               |             |              |             |
| Full-Time                           | 1             | 1           | 1            | 1           |
| Part-Time                           | 0.981         | (0.956–1.007)| 0.974        | (0.915–1.036)|
| Unemployed                          | 0.696         | (0.683–0.708)| 0.868        | (0.812–0.928)|
| Not in Labor Force                  | 1.025         | (1.006–1.044)| 0.770        | (0.717–0.827)|
| **Primary Source of Income**       |               |             |              |             |
| Wages/Salary                        | 1             | 1           | 1            | 1           |
| Public Assistance                   | 1.925         | (1.872–1.980)| 1.265        | (1.175–1.361)|
| Retirement/Pension or Disability    | 1.898         | (1.840–1.957)| 1.241        | (1.147–1.343)|
| Other                               | 1.049         | (1.024–1.075)| 0.989        | (0.923–1.059)|
| None                                | 0.411         | (0.402–0.420)| 0.991        | (0.928–1.059)|
| Health Insurer                      | 1             | 1           | 1            | 1           |

(Continued)
Compared to those who were never married, those who were separated, divorced, or widowed showed higher odds of waiting over a week to enter treatment. Those in a dependent living situation or homeless showed lower odds of waiting over a week to enter treatment compared to those who reported living independently. No statistically significant difference was observed in the odds of waiting over a week to enter treatment between veterans and non-veterans. Those working part-time showed higher odds of waiting over a week to enter treatment vis-à-vis those working in full-time employment. Moreover, those reporting no primary source of income showed lower odds of waiting over a week to enter treatment than those reporting a primary income from wages/salary. Those covered by Medicaid showed lower odds of waiting over a week to enter treatment compared to those who were insured privately.

**Institutional characteristics.** Admissions to all examined non-hospital settings were associated with lower odds of waiting over a week to enter treatment. Compared those who were individually referred for treatment (including self-referrals), those who were referred by an alcohol/drug abuse care provider, other community referrer, or the criminal justice system showed higher odds of waiting over a week to enter treatment. In addition, those reporting alcohol or benzodiazepines at admission also showed higher odds of waiting over a week to enter treatment.

**Discussion**

Our findings highlight several differences in the receipt of OAT and waiting time to enter treatment on patient sociodemographic, institutional and behavioural characteristics. Firstly, we note that only a minority of patients admitted for OUD receive OAT with some

| Characteristic                                      | Unadjusted | AOR 95% CI     | Adjusted†  |
|----------------------------------------------------|------------|----------------|-------------|
|                                                    | OR         | 95% CI         | Adjusted†   |
| Medicaid                                           | 3.556      | (3.423–3.694)  | 1.676       | (1.579–1.779) |
| Medicare or Other                                   | 1.377      | (1.312–1.445)  | 1.348       | (1.242–1.464) |
| Uninsured                                          | 0.615      | (0.589–0.641)  | 1.049       | (0.986–1.116) |
| Service Setting at Time of Admission               |            |                |             |
| Hospital                                           |            |                |             |
|                                                    | 1          |                | 1           |
| Short-Term                                         | 1.071      | (0.893–1.284)  | 4.455       | (1.076–18.45) |
| Long-Term                                          | 1.016      | (0.845–1.220)  | 3.986       | (0.960–16.56) |
| Ambulatory, Intensive Outpatient                   | 1.830      | (1.528–2.192)  | 5.420       | (1.310–22.42) |
| Ambulatory, Non-Intensive Outpatient               | 13.24      | (11.07–15.83)  | 37.69       | (9.116–155.9) |
| Primary Source of Referral                         |            |                |             |
| Individual (including Self-Referral)               |            |                | 1           |
| Alcohol/Drug Abuse Care Provider                   | 0.323      | (0.314–0.331)  | 0.437       | (0.410–0.467) |
| Other Health Care Provider                         | 0.261      | (0.254–0.268)  | 0.512       | (0.482–0.543) |
| Educational Institution                            | 0.129      | (0.0892–0.188) | 0.114       | (0.0438–0.294) |
| Employer                                           | 0.0717     | (0.0584–0.0881) | 0.101    | (0.0636–0.159) |
| Other Community Referral                           | 0.385      | (0.377–0.393)  | 0.253       | (0.241–0.266) |
| Court/Criminal Justice Referral/DUI                | 0.0558     | (0.0544–0.0574)| 0.0686     | (0.0651–0.0724) |
| Alcohol or Benzodiazepines Reported at Admission   | 0.287      | (0.282–0.292)  | 0.464       | (0.445–0.484) |

*Adjusted for year, state, age, sex, ethnicity, marital status, living arrangement, veteran status, years of education, employment status, primary source of income, health insurer, census division, service setting at time of admission, primary source of referral, and alcohol/benzodiazepine report at admission.

https://doi.org/10.1371/journal.pone.0226349.t003
Table 4. Logistic regression estimates for over one week spent waiting to enter treatment for opioid use disorder among admitted patients, 2014–17.

| Characteristic | Unadjusted | Adjusted* |
|----------------|------------|-----------|
|                | OR  95% CI | AOR  95% CI |
| Age            |            |           |
| 18–20          | 1          | 1         |
| 21–24          | 0.949 (0.888–1.013) | 1.047 (0.941–1.165) |
| 25–29          | 0.886 (0.832–0.944) | 1.119 (1.009–1.241) |
| 30–34          | 0.821 (0.770–0.876) | 1.077 (0.968–1.198) |
| 35–39          | 0.825 (0.771–0.883) | 1.080 (0.965–1.210) |
| 40–44          | 0.684 (0.634–0.737) | 0.966 (0.854–1.095) |
| 45–49          | 0.622 (0.576–0.671) | 1.069 (0.942–1.213) |
| 50–54          | 0.516 (0.475–0.560) | 0.954 (0.834–1.092) |
| 55+            | 0.483 (0.446–0.523) | 0.889 (0.773–1.022) |
| Female         | 0.999 (0.974–1.024) | 1.010 (0.968–1.055) |
| Ethnicity      |            |           |
| White          | 1          | 1         |
| Black or African American | 0.574 (0.551–0.598) | 0.886 (0.833–0.943) |
| Asian or Pacific Islander | 0.821 (0.722–0.932) | 0.924 (0.753–1.134) |
| Native American | 1.115 (0.997–1.246) | 0.977 (0.807–1.183) |
| Other          | 0.967 (0.921–1.015) | 0.980 (0.861–1.114) |
| Marital Status |            |           |
| Never Married  | 1          | 1         |
| Married        | 1.057 (1.015–1.101) | 1.030 (0.968–1.096) |
| Separated      | 1.215 (1.145–1.290) | 1.156 (1.058–1.264) |
| Divorced or Widowed | 1.149 (1.101–1.200) | 1.137 (1.063–1.216) |
| Living Arrangement |        |           |
| Independent    | 1          | 1         |
| Dependent      | 1.119 (1.084–1.155) | 0.933 (0.883–0.986) |
| Homeless       | 1.262 (1.212–1.315) | 0.892 (0.823–0.967) |
| Veteran Status | 1.038 (0.955–1.129) | 0.910 (0.798–1.037) |
| Years of Education |        |           |
| <8 Years       | 1          | 1         |
| 9–11 Years     | 1.076 (1.004–1.152) | 1.115 (1.003–1.238) |
| 12 Years       | 1.051 (0.984–1.122) | 1.069 (0.968–1.181) |
| 13–15 Years    | 1.382 (1.290–1.482) | 1.103 (0.991–1.227) |
| 16+ Years      |            |           |
| Employment Status |        |           |
| Full-Time      | 1          | 1         |
| Part-Time      | 1.125 (1.065–1.188) | 1.209 (1.114–1.313) |
| Unemployed     | 1.093 (1.052–1.135) | 1.060 (0.970–1.158) |
| Not in Labor Force | 0.864 (0.831–0.899) | 1.019 (0.928–1.119) |
| Primary Source of Income |        |           |
| Wages/Salary   | 1          | 1         |
| Public Assistance | 0.680 (0.639–0.723) | 0.956 (0.863–1.059) |
| Retirement/Pension or Disability | 0.691 (0.647–0.737) | 0.978 (0.876–1.093) |
| Other          | 0.684 (0.645–0.726) | 0.966 (0.878–1.062) |
| None           | 1.207 (1.163–1.254) | 0.894 (0.823–0.970) |
| Health Insurer |            |           |
| Private        | 1          | 1         |

(Continued)
subpopulations exhibiting much lower receipt of OAT than others. For instance, only 18% of those aged 18–20 received OAT compared to almost 60% of patients aged 55 and over who received OAT. Similarly, while approximately three-quarters of admitted patients were treated with no reported wait time, some subpopulations reported differentially higher rates of those waiting for over a week to enter treatment, such as those aged 18–20, those who were privately insured and those admitted to the hospital setting. Some subpopulations showed higher odds of receipt of OAT, including all age groups older than the reference group of patients aged 18–20, Native Americans, patients whose primary source of income was public assistance or retirement/pension or disability funds, those insured on Medicaid or Medicare, and those admitted to non-hospital care settings. By contrast, some groups showed lower odds of receipt of OAT, including those with a marital status other than the reference group who were never married, those in a dependent living situation or homeless, and those patients for whom the primary source of referral was anything other than an individual referral. With respect to covariates associated with increased odds of waiting over a week to enter treatment, our analysis highlighted several groups, including those who were separated, divorced, or widowed, those working part-time, and those who were referred by alcohol/drug abuse care providers, community referrers, or the criminal justice system.

Our analysis is necessarily limited by use of the TEDS-A dataset. Firstly, given the relative complexity of reporting from the facility to the state to the Federal level, variations on reporting mechanisms by state may have downstream effects on the quality of data at the national level [30]. In addition, information on days waiting to enter treatment are collected through TEDS Supplementary Data which is voluntary [19]. As such, facilities with longer waiting times may choose not to submit this information thereby contributing a level of reporting bias.

### Table 4. (Continued)

| Characteristic                                      | Unadjusted | Adjusted* |
|----------------------------------------------------|------------|-----------|
|                                                     | OR         | 95% CI    | AOR       | 95% CI    |
| Medicaid                                           | 0.522      | (0.491–0.555) | 0.914     | (0.846–0.987) |
| Medicare or Other                                   | 0.871      | (0.803–0.945) | 0.975     | (0.881–1.080) |
| Uninsured                                          | 1.045      | (0.982–1.112) | 0.964     | (0.894–1.039) |
| Service Setting at Time of Admission               |            |           |           |           |
| Hospital                                           |            |           |           |           |
| Short-Term                                         | 0.273      | (0.216–0.344) | 0.382     | (0.284–0.514) |
| Long-Term                                          | 0.389      | (0.308–0.491) | 0.547     | (0.405–0.740) |
| Ambulatory, Intensive Outpatient                   | 0.180      | (0.142–0.227) | 0.221     | (0.164–0.297) |
| Ambulatory, Non-Intensive Outpatient               | 0.133      | (0.105–0.167) | 0.243     | (0.181–0.326) |
| Primary Source of Referral                         |            |           |           |           |
| Individual (including Self-Referral)               |            |           |           |           |
| Alcohol/Drug Abuse Care Provider                   | 1.885      | (1.802–1.973) | 1.322     | (1.226–1.426) |
| Other Health Care Provider                         | 1.536      | (1.451–1.626) | 1.024     | (0.933–1.124) |
| Educational Institution                            | 1.848      | (1.060–3.221) | 0.909     | (0.317–2.609) |
| Employer                                           | 1.823      | (1.332–2.495) | 1.414     | (0.904–2.210) |
| Other Community Referral                           | 1.316      | (1.260–1.374) | 1.789     | (1.668–1.918) |
| Court/Criminal Justice Referral/DUI                | 2.270      | (2.204–2.338) | 1.805     | (1.716–1.899) |
| Alcohol or Benzodiazepines Reported at Admission   | 1.646      | (1.599–1.695) | 1.226     | (1.171–1.283) |

*Adjusted for year, state, age, sex, ethnicity, marital status, living arrangement, veteran status, years of education, employment status, primary source of income, health insurer, census division, service setting at time of admission, primary source of referral, and alcohol/benzodiazepine report at admission.

https://doi.org/10.1371/journal.pone.0226349.t004
to our analysis leading to the underestimation of actual waiting times to enter treatment. Importantly, inferences regarding national trends and patterns are limited given that 7 states did not report any patients in receipt of OAT and 13 states did not report time waiting to enter treatment. Many of these states are critical to accurately assessing these outcomes respectively, at a national level and so our inferences should be interpreted cautiously without their inclusion. Additionally, given that our analyses are limited to only first-time admissions for the treatment of OUD, we do not include subsequent admissions for the treatment of OUD following admissions for detoxification or prior admissions for treatment. We recognise that this may distort our estimates of OAT for the treatment of OUD, given that an individual may be admitted several times before receiving OAT. Moreover, TEDS-A does not include the use of OATs in the primary care setting and, consequently, conclusions regarding the use of OATs in primary care cannot be drawn from our analysis though data on the topic is available in established literature [31–33]. Nevertheless, no other dataset exists at the national level which provides comparable data to TEDS-A. Consequently, despite the limitations presented here, our study draws upon the largest extant dataset to provide information on OAT and time waiting to enter treatment.

Addressing differences in treating individuals affected by OUD is a chief concern for policymakers and care providers. One systematic review of determinants of opioid-related mortality in the United States and Canada has found opioid-related mortality trends tend to vary considerably by sociodemographic differences, including ethnicity, gender, age, and socioeconomic status, as we have highlighted here [34]. For many of these subpopulations, differences in the treatment of OUD occurs concomitantly with differential treatment more generally, exacerbating existing known disparities in healthcare provision based on factors such as race [35]. Indeed, failure to treat OUD must be considered more widely. Perlman and Jordan, for instance, highlight the complex inter-relationships among opioid misuse and overdose, hepatitis C, and HIV as a syndemic with disproportionately adverse results for individuals at heightened risk [36]. These concurrent conditions may further problematize the treatment of OUD and, indeed, may contribute to a myriad of downstream metabolic comorbidities although much remains unknown [37]. In addition, our findings regarding individuals referred by the criminal justice system are consistent with the literature regarding the relatively low uptake of pharmacotherapy for opioid use disorder among incarcerated individuals [38], a subgroup which has exhibited a heightened risk of opioid overdose mortality following post-release [39]. As a result, OUD, taken in context of wider trends in population health, is increasingly an urgent priority and differences in treatment must be addressed both in the near- and long-term.

Our analysis highlights a number of areas for further scrutiny. Firstly, although OAT is widely considered the standard of care for OUD, only a minority of admitted patients receive it. Moreover, variations in who receives OAT and time to enter treatment based on sociodemographic and institutional characteristics highlight further areas for further study and potential intervention. In addition, further research is needed regarding personalised approaches to characterising the inheritable factors which contribute towards heightened risk of OUD as well as potential avenues for more effective treatment [40]. Nevertheless, given the limitations of the TEDS-A dataset, we are unable to unravel the causal mechanisms which underlie these differences. Stigma is commonly cited as a major factor which attenuates greater uptake of OAT for the treatment of OUD but access remains strictly controlled and also contributes to some patterns we have highlighted here [41]. Further attention is warranted to understand how and why these differences exist and persist in order to formulate appropriate policy responses.
Author Contributions
Conceptualization: Justin C. Yang.
Data curation: Justin C. Yang.
Formal analysis: Justin C. Yang.
Investigation: Justin C. Yang.
Methodology: Justin C. Yang, Andres Roman-Urrestarazu.
Project administration: Andres Roman-Urrestarazu, Carol Brayne.
Supervision: Andres Roman-Urrestarazu, Carol Brayne.
Validation: Justin C. Yang.
Visualization: Justin C. Yang.
Writing – original draft: Justin C. Yang.
Writing – review & editing: Andres Roman-Urrestarazu, Carol Brayne.

References
1. Degenhardt L, Charlson F, Mathers B, Hall WD, Flaxman AD, Johns N, et al. The global epidemiology and burden of opioid dependence: results from the global burden of disease 2010 study. Addiction. 2014; 109(8):1320–33. Epub 2014/03/26. https://doi.org/10.1111/add.12551 PMID: 24661272.
2. Kolodny A, Courtwright DT, Hwang CS, Kreiner P, Eadie JL, Clark TW, et al. The prescription opioid and heroin crisis: a public health approach to an epidemic of addiction. Annual review of public health. 2015; 36:559–74. Epub 2015/01/13. https://doi.org/10.1146/annurev-publhealth-031914-122957 PMID: 25581144.
3. Yang JC, Roman-Urrestarazu A, Brayne C. Binge alcohol and substance use across birth cohorts and the global financial crisis in the United States. PLoS One. 2018; 13(6):e0199741. Epub 2018/06/26. https://doi.org/10.1371/journal.pone.0199741 PMID: 29940033.
4. Armenian P, Vo KT, Barr-Walker J, Lynch KL. Fentanyl, fentanyl analogs and novel synthetic opioids: A comprehensive review. Neuropharmacology. 2018; 134(Pt A):121–32. Epub 2017/10/19. https://doi.org/10.1016/j.neuropharm.2017.10.016 PMID: 29042317.
5. Rudd RA. Increases in drug and opioid-involved overdose deaths—United States, 2010–2015. MMWR Morbidity and mortality weekly report. 2016; 65.
6. Chen LY, Strain EC, Crum RM, Mojtabai R. Gender differences in substance abuse treatment and barriers to care among persons with substance use disorders with and without comorbid major depression. J Addict Med. 2013; 7(5):325–34. Epub 2013/10/05. https://doi.org/10.1097/ADM.0b013e31829b7afe PMID: 24091763.
7. Choi NG, DiNitto DM, Marti CN. Treatment use, perceived need, and barriers to seeking treatment for substance abuse and mental health problems among older adults compared to younger adults. Drug Alcohol Depend. 2014; 145:113–20. Epub 2014/12/03. https://doi.org/10.1016/j.drugalcdep.2014.10.004 PMID: 25465752.
8. Blanco C, Iza M, Schwartz RP, Rafful C, Wang S, Olsson M. Probability and predictors of treatment-seeking for prescription opioid use disorders: a national study. Drug Alcohol Depend. 2013; 131(1–2):143–8. Epub 2013/01/12. https://doi.org/10.1016/j.drugalcdep.2012.12.013 PMID: 23360977.
9. Krawczyk N, Feder KA, Fingerhood ML, Saloner B. Racial and ethnic differences in opioid agonist treatment for opioid use disorder in a U.S. national sample. Drug and Alcohol Dependence. 2017; 178:512–8. https://doi.org/10.1016/j.drugalcdep.2017.06.009 PMID: 28719885.
10. Peles E, Schreiber S, Adelson M. Opiate-Dependent Patients on a Waiting List for Methadone Maintenance Treatment Are at High Risk for Mortality Until Treatment Entry. 2013; 7(3):177–82. https://doi.org/10.1097/ADM.0b013e318287cf9 PMID: 23519049.
11. Quinn PD, Hur K, Chang Z, Krebs EE, Bair MJ, Scott EL, et al. Incident and long-term opioid therapy among patients with psychiatric conditions and medications: a national study of commercial health care claims. Pain. 2017; 158(1):140–8. Epub 2016/12/17. https://doi.org/10.1097/j.pain.000000000000730 PMID: 27984526.
12. Short VL, Hand DJ, MacAfee L, Abatemarco DJ, Terplan M. Trends and disparities in receipt of pharmacotherapy among pregnant women in publicly funded treatment programs for opioid use disorder in the United States. Journal of substance abuse treatment. 2018; 89:67–74. Epub 2018/05/01. https://doi.org/10.1016/j.jsat.2018.04.003 PMID: 29706175.

13. Fullerton CA, Kim M, Thomas CP, Lyman DR, Montejano LB, Dougherty RH, et al. Medication-Assisted Treatment With Methadone: Assessing the Evidence. Psychiatric Services. 2014; 65(2):146–57. https://doi.org/10.1176/appi.ps.201300235 PMID: 24248468.

14. Thomas CP, Fullerton CA, Kim M, Montejano L, Lyman DR, Dougherty RH, et al. Medication-Assisted Treatment With Buprenorphine: Assessing the Evidence. Psychiatric Services. 2014; 65(2):158–70. https://doi.org/10.1176/appi.ps.201300256 PMID: 24247147.

15. Jaffe JH, O’Keeffe C. From morphine clinics to buprenorphine: regulating opioid agonist treatment of addiction in the United States. Drug Alcohol Depend. 2003; 70(2 Suppl):S3–11. Epub 2003/05/10. https://doi.org/10.1016/S0376-8716(03)00055-3 PMID: 12738346.

16. Jones CM, Campopiano M, Baldwin G, McCance-Katz E. National and State Treatment Need and Capacity for Opioid Agonist Medication-Assisted Treatment. Am J Public Health. 2015; 105(8):e55–63. Epub 2015/06/13. https://doi.org/10.2105/AJPH.2015.302664 PMID: 26066931.

17. Lofwall MR, Havens JR. Inability to access buprenorphine treatment as a risk factor for using diverted buprenorphine. Drug Alcohol Depend. 2012; 126(3):379–83. Epub 2012/06/19. https://doi.org/10.1016/j.drugalcdep.2012.05.025 PMID: 22704124.

18. Gryczynski J, Schwartz RP, Salkever DS, Mitchell SG, Jaffe JH. Patterns in admission delays to outpatient methadone treatment in the United States. Journal of substance abuse treatment. 2011; 41(4):431–9. https://doi.org/10.1016/j.jsat.2011.06.005 PMID: 21821378.

19. Substance Abuse Mental Health Services Administration CBHSQ. Treatment Episode Data Set (TEDS): 2004–2014. National Admissions to Substance Abuse Treatment Services. No BHSIS Series S-84, HHS Publication No SMA 16–4986. 2016.

20. Krawczyk N, Picher CE, Feder KA, Saloner B. Only One In Twenty Justice-Referrer Adults In Specialty Treatment For Opioid Use Receive Methadone Or Buprenorphine. Health Affairs. 2017; 36(12):2046–53. https://doi.org/10.1377/hlthaff.2017.0890 PMID: 29200340.

21. Kampman K, Jarvis M. American Society of Addiction Medicine (ASAM) National Practice Guideline for the Use of Medications in the Treatment of Addiction Involving Opioid Use. Journal of addiction medicine. 2015; 9(5):358–67. https://doi.org/10.1097/ADM.0000000000000166 PMID: 26406300.

22. Bachhuber MA, Mehta PK, Faherty LJ, Saloner B. Medicaid Coverage of Methadone Maintenance and the Use of Opioid Agonist Therapy Among Pregnant Women in Specialty Treatment. Medical care. 2017; 55(12):985–90. Epub 2017/11/15. https://doi.org/10.1097/MLR.0000000000000803 PMID: 29135769.

23. Chhatre S, Cook R, Mallik E, Jayadevappa R. Trends in substance use admissions among older adults. BMC health services research. 2017; 17(1):584. Epub 2017/08/24. https://doi.org/10.1186/s12913-017-2536-z PMID: 28830504.

24. Huhn AS, Strain EC, Tompkins DA, Dunn KE. A hidden aspect of the U.S. opioid crisis: Rise in first-time treatment admissions for older adults with opioid use disorder. Drug Alcohol Depend. 2018; 183:142–7. Epub 2018/11/02. https://doi.org/10.1016/j.drugalcdep.2018.10.002 PMID: 30384321.

25. Krawczyk N, Picher CE, Feder KA, Saloner B. Only One In Twenty Justice-Referrer Adults In Specialty Treatment For Opioid Use Receive Methadone Or Buprenorphine. Health Affairs (Millwood). 2017; 36(12):2046–53. Epub 2017/12/05. https://doi.org/10.1377/hlthaff.2017.0890 PMID: 29200340.

26. Peindl KS, Mannelli P, Wu LT, Patkar AA. Trends in nonheroin opioid abuse admissions: 1992–2004. Journal of opioid management. 2007; 3(4):215–23. Epub 2007/10/26. https://doi.org/10.5055/jom.2007.0007 PMID: 17957981.

27. Rivers PA, Dobalian A, Oyane TJ, Bae S. Socioeconomic determinants of planned methadone treatment. American journal of health behavior. 2006; 30(5):451–9. Epub 2006/08/09. PMID: 16893307.

28. Uchtenhagen A, Ladjevic T, Rehm J. JWGPAPOD. WHO guidelines for psychosocially assisted pharmacological treatment of persons dependent on opioids. 2007.

29. Stata Statistical Software. Release 14 [computer program]. 2013.

30. Carise D, McLellan AT, Gilford LS, Kleber HD. Developing a National Addiction Treatment Information System: An Introduction to the Drug Evaluation Network System. Journal of substance abuse treatment. 1999; 17(1):67–77. https://doi.org/10.1016/S0740-5472(98)00047-6.

31. Dick AW, Pacula RL, Gordon AJ, Sorbero M, Burns RM, Leslie D, et al. Growth In Buprenorphine Waivers For Physicians Increased Potential Access To Opioid Agonist Treatment. 2002–11. Health Affairs. 2015; 34(6):1028–34. https://doi.org/10.1377/hlthaff.2014.1205 PMID: 26056209.
32. Stein BD, Gordon AJ, Dick AW, Burns RM, Pacula RL, Farmer CM, et al. Supply of buprenorphine waivered physicians: The influence of state policies. Journal of substance abuse treatment. 2015; 48 (1):104–11. https://doi.org/10.1016/j.jsat.2014.07.010. PMID: 25218919

33. Stein BD, Pacula RL, Gordon AJ, Burns RM, Leslie DL, Sorbero MJ, et al. Where Is Buprenorphine Dispensed to Treat Opioid Use Disorders? The Role of Private Offices, Opioid Treatment Programs, and Substance Abuse Treatment Facilities in Urban and Rural Counties. The Milbank Quarterly. 2015; 93 (3):561–83. https://doi.org/10.1111/1468-0009.12137 PMID: 26350930

34. King NB, Fraser V, Boikos C, Richardson R, Harper S. Determinants of increased opioid-related mortality in the United States and Canada, 1990–2013: a systematic review. American journal of public health. 2014; 104(8):e32–e42. https://doi.org/10.2105/AJPH.2014.301966 PMID: 24922138

35. Santoro TN, Santoro JD. Racial Bias in the US Opioid Epidemic: A Review of the History of Systemic Bias and Implications for Care. Cureus. 2018; 10(12):e3733. Epub 2019/02/26. https://doi.org/10.7759/cureus.3733 PMID: 30800543.

36. Perlman DC, Jordan AE. The Syndemic of Opioid Misuse, Overdose, HCV, and HIV: Structural-Level Causes and Interventions. Current HIV/AIDS reports. 2018; 15(2):96–112. Epub 2018/02/21. https://doi.org/10.1007/s11904-017-0390-3 PMID: 29460225.

37. Hileman CO, McComsey GA. The Opioid Epidemic: Impact on Inflammation and Cardiovascular Disease Risk in HIV. Current HIV/AIDS reports. 2019; 16(5):381–8. Epub 2019/09/02. https://doi.org/10.1007/s11904-019-00463-4 PMID: 31473903.

38. Schwartz R, Sharma A, O’Grady K, Kelly S, Gryczynski J, Mitchell S. Pharmacotherapy for opioid dependence in jails and prisons: research review update and future directions. Substance Abuse and Rehabilitation. 2016; 27. https://doi.org/10.2147/sar.s81602 PMID: 27217808

39. Joudrey PJ, Khan MR, Wang EA, Scheidell JD, Edelman EJ, McInnes DK, et al. A conceptual model for understanding post-release opioid-related overdose risk. Addiction Science & Clinical Practice. 2019; 14(1). https://doi.org/10.1186/s13722-019-0145-5 PMID: 30982468

40. Kreek MJ, Reed B, Butelman ER. Current status of opioid addiction treatment and related preclinical research. Science Advances. 2019; 5(10):eaax9140. https://doi.org/10.1126/sciadv.aax9140 PMID: 31616793

41. Bell J, Strang J. Medication Treatment of Opioid Use Disorder. Biol Psychiatry. 2019. Epub 2019/08/20. https://doi.org/10.1016/j.biopsych.2019.06.020 PMID: 31420089.