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Evaluating the impact of Medication for Opioid Use Disorder Treatment Policies in California Jails

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A dissertation

submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

University of Washington

2022

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Program Authorized to Offer Degree:

Epidemiology

University of Washington

Abstract

Evaluating the Impact of Medication for Opioid Use Disorder Treatment Policies in California Jails

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This mixed methods dissertation evaluates how offering medications for opioid use disorder (OUD) treatment in county jails impacts: 1) treatment uptake and access among those with an OUD (Aim 1); and 2) county-level population outcomes to inform policy and program development (Aim 2). In Aim 1, we identified several barriers to accessing MOUD, including fear/mistrust of prison and jail staff, logistics, cost, and stigma/discrimination. Respondents desired more logistic support for treatment appointments and warm connections from service providers post-incarceration. In Aim 2, we found that counties with jail-based opioid agonist therapy saw significant reductions in their overall and non-drug arrests rates, methadone-involved deaths, heroin-involved deaths, and heroin overdose deaths. However, we also observed increases in drug-related arrests, non-drug convictions, and property convictions. Counties that had OAT maintenance policies for at least 12 months saw decreases in their opioid overdose ED visits, while counties with OAT maintenance and induction policies for 12+ months saw increases in overdose visits. This dissertation provides important insight into the impact that jail-based OAT policies have at the population-level and couples it with feedback from the community of people who use drugs and were formerly incarcerated in one California county.

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ACKNOWLEDGEMENTS

This research was funded by a National Institutes of Justice Dissertation Fellowship in the Social and Behavioral Sciences (Grant # 2019-R2-CX-0006) and the University of Washington's Magnuson scholarship (awarded 2020-2021).

This work would not have been possible without support from the following individuals graciously lending their expertise and time freely while also providing vital key contacts:

- Danielle Russell
- Jacqueline van Wormer
- Donna Strugar-Fritsch
- Andy Fyne
- Chris Brown
- Dominique McDowell
- Jeffrey DeVido
- Stephanie Ruckman
- Marin County, Department of Health and Human Services
- University of Washington, Department of Epidemiology

DEDICATION

I could not have possibly imagined what it would feel like to go through the personal and sometimes isolating experience of writing this dissertation. I would not be where I am today without the many mentors, formal and informal, who have supported and encouraged me along the way. Thanks to: 1) Dr. Ann G. Matthysse, who first introduced me to the scientific process and made me believe that I could be a scientist. 2) Neel Gandhi, Carla Jeffries, and Roque Miramontes – thank you for setting a high bar for mentorship and helping me launch my career in public health. 3) Janet Baseman, who introduced me to the world of academic applied public health and served as a role model for shepherding applied public health as a key force in academia, I have learned so much from working with you and the many opportunities you provided. To my remaining committee members: a huge thanks to Caleb Banta-Green for sharing his wealth of expertise in substance use disorder research and treatment even amidst a busy schedule. To Patrick Heagerty, who is truly a master in translating complex biostatistical concepts into something that is as rigorous as it is practical and interpretable, thank you for sharing your time and expertise. And lastly, to my dissertation chair, Ali Rowhani-Rahbar: I feel so lucky to be mentored by you. Your consistent commitment to your mentees is self-evident in anyone who has the pleasure of working with you. You truly go above and beyond to ensure your students learn complex methods, thoughtfully conduct their research, and always push them to realize the implications of their work. Thank you for always sharing your kindness and humanity in addition to your brilliance and expertise.

To my fellow training epidemiologists in the School of Public Health – I have learned so much from each of you and your work. You made stressful exams and coursework fun and I can't wait to brag "I know them!" when I see your future work. Special gratitude to Pauline Trinh – it is a gift to our friendship and curse to our brains that our anxieties mirror one another. You are and were always the best cheerleader during low moments and a brilliant go-to person to talk through research ideas and execution.

A huge thank you to the Marin County Department of Health & Human Services Epidemiology Team for their continued support both professionally and emotionally. I am the epidemiologist I am today because of each of you. Particular gratitude to Rochelle Ereman and Matthew Willis, who provide endless and thoughtful mentorship. I am so grateful for the space you both provide for your trainees to grow and learn. You were both integral to me being able to conduct this dissertation in Marin County and California.

To my friends and family who have been cheering me on these past five years: I promise this will be the last graduation you have to attend. Thank you for always believing in me. To my brilliant and driven mother, Kimberlea Patrick: thank you for showing me what it looks like to chase your passion and love what you do while always instilling in me a belief that I could tackle any challenge life threw my way. I also cherished the letters, phone calls, and cross-country virtual hugs from my grandmothers, Nancy Hannah and Marion Patrick. Last but certainly not least, thank you to my partner, Andrew Couch, and our dog, Blue, for lifting me up when I needed it, always making sure I set down work at some point, and giving me an easy excuse for daily walks.

INTRODUCTION

Drug overdose is the leading cause of unintentional death in the U.S., and the majority of these deaths involve opioids.[1,2] In 2016, opioids were involved in 42,249 drug overdose deaths, with approximately 12 million individuals 12 years or older reporting past-year opioid misuse.[2] Those with an opioid use disorder (OUD) are more likely to have a history of involvement in the criminal legal system (CLS) those without an OUD.[3] Nine million Americans cycle in and out of jails each year, with an average daily jail population of approximately 700,000 in 2020, a reduction from prior years as a result of decarceration during the COVID-19 pandemic.[7] With increasing evidence of the harms of losing access to effective OUD treatment, many have called for OUD treatment to be offered within the CLS, which encompasses jails, prisons, the court system, policing and police diversion programs, and probation and parole.[4–6] Our objective is to evaluate the population-level impact of jail-based medication for opioid use disorder (MOUD) treatment policies while also soliciting policy and program preferences from people who use drugs and were formerly incarcerated to inform policy and program development.

Using medications to treat an OUD has been demonstrated as highly effective in many settings.[8–12] Two systematic reviews of studies within the CLS demonstrated that the provision of methadone during incarceration significantly increased engagement in treatment post-release, and reduced both illicit opioid use and injection drug use post-release.[9,10] Methadone and naltrexone maintenance have been shown to reduce criminal involvement in Europe, with mixed or limited evidence on their impact on crime rates in the U.S.[9,12] Increased access to these medications may improve CJ outcomes and enhance public safety through reducing the demand for and use of illicit drugs.

Forced abstinence from opioid use during incarceration is associated with severe, unmanaged withdrawal and aversion to medications for OUD treatment upon release.[6,13,14] Additionally, those with an OUD often experience reduced tolerance towards opioids due to abstinence during incarceration, which may explain an observed increased risk of a fatal overdose immediately following release.[6,15] As communities develop policies to prevent opioid-related harms, research studies are needed to understand how treatment uptake and delivery impact the success of treatment policies.

AIM 1: IDENTIFY FACILITATORS OF AND BARRIERS TO ACCESSING OUD TREATMENT SERVICES DURING INCARCERATION AND POST-RELEASE AMONG THOSE EXPOSED TO THE CRIMINAL LEGAL SYSTEM IN MARIN COUNTY, CALIFORNIA

Title: "Once you get dropped… nobody answers:" barriers to accessing medications for opioid use disorder treatment and policy preferences among people who use drugs and have been incarcerated

Abstract

Many people with an opioid use disorder (OUD) interact with the criminal legal system (CLS). Access to medications for OUD treatment (MOUD) during incarceration influences people who use drugs (PWUD)'s willingness to engage in services. We conducted a qualitative study in Marin County, California among formerly incarcerated PWUD to identify policy recommendations for accessing MOUD. In 2021, 20 people with an OUD and recent incarceration (<5 years) participated in one-on-one interviews after accessing harm reduction services or MOUD at a clinic. A grounded theory qualitative data analysis was conducted by two independent coders, including one who is currently taking methadone. Most participants were white (60% n=12), male (55% n=11), not currently receiving MOUD (70% n=14), and incarcerated within two years (60% n=12) in a jail (93% n=18). Many participants (55%, n=11) expressed that MOUD traded one addiction for another; however, 60% (n=12) were supportive of MOUD. Most (55%, n=11) participants experienced opioid withdrawal during incarceration. Several participants reported feeling their opioid withdrawal was only treated if severe (30% n=6), a theme which women and people identifying as Hispanic/Latina/o, Black, Native American, or multi-racial supported more often. Respondents of color supported themes of fear/mistrust of providers more often than white respondents, partially driven by feeling that they only had so many chances with treatment providers before services are discontinued. Common policy and service preferences were to approach PWUD with empathy and respect (60% n=12) and involve people with lived experience as service providers (40% n=8). People with an OUD who were formerly incarcerated were supportive of MOUD while also expressing a preference for abstinence as the sole goal of treatment. Mistrust in service providers may be driving people's willingness to engage with or seek services and be more concentrated among people who use drugs who are Black, Native American, Hispanic/Latina/o, or Multi-racial.

Introduction

Approximately 2.5 million people ages 12 and older in the US have an opioid use disorder (OUD) [16]. Those with an OUD are more likely to have a history of involvement in the criminal legal system (CLS) through arrests or incarcerations than those without an OUD; 51% of individuals with an OUD involving pharmaceuticals and 77% of those using heroin reported lifetime involvement with the CLS [3]. From 2007-2009, 17% of state prisoners and 19% of jail inmates reported regularly using heroin and other opioids, both of which increased significantly from prior years [17]. There is a high burden of opioid use and OUDs among those interfacing with the CLS, resulting in many national and international calls to offer evidence-based OUD treatment options within this system [4–6,18–20].

Using opioid agonist medications, which include methadone and buprenorphine, to treat an OUD has been demonstrated as highly effective in reducing opioid use, both self-reported and as measured by urine drug tests, and improving retention in treatment, in many settings [21–25]. Three types of medications are approved by the US Food and Drug Administration to treat an OUD: methadone, buprenorphine, and naltrexone [26,27]. Methadone and buprenorphine have evidence of effectiveness in treating OUD and reducing the risk of overdose and need for opioid-related acute care as compared to psychological or opioid antagonist treatment. However, naltrexone, an opioid antagonist, has shown mixed effectiveness in preventing overdose deaths, with some evidence that it may increase death by lowering opioid tolerance for those who return to drug use [28–30]. According to the National Survey of Drug use and Health, nearly 11% of those with an OUD in the US, an estimated 278,000 people, received medications for opioid use disorder (MOUD) treatment in 2020 [16].

Despite the effectiveness of opioid agonist medications, few individuals are referred to or offered medications for OUD treatment through the CLS [31,32]. This lack of treatment increases the risk of death and changes perceptions towards treatment among people who use drugs (PWUD). Forced abstinence from opioid use during incarceration has been associated with severe, unmanaged withdrawal and aversion to initiating MOUD treatment in the community for fear of becoming incarcerated and losing access to these medications [6,13,14,33]. Prior estimates from many settings indicate a significantly higher risk of death due to an opioid overdose than the general population, with the most significant risk experienced within the first two weeks of release [34–36]. Some of this risk is driven by a return to drug use after a period of abstinence during incarceration – 75% of formerly incarcerated individuals with an OUD relapse within three months of release [14,37]. As a result, retention in opioid agonist treatment during incarceration results in substantial reductions in the risk of death among those with an OUD [38].

Increasing access to MOUD among people exposed to the CLS is indicated by the severity of OUD and risk of overdose, however, MOUDs remain underutilized. Many researchers have called for the inclusion of PWUD as key actors in policy and program development, citing their unique expertise about drug use behaviors and trusted relationships with other PWUD [39–41]. However, PWUD are often not systematically included in these activities, which may be a result of: 1) PWUD not trusting the intentions of policymakers and public health practitioners due to discrimination and stigma they have experienced from these systems; and 2) PWUD not being invited to participate in studies due to stigma from policymakers and researchers [41–43]. We sought to integrate the voices of PWUD in MOUD policies and programs offered in jail and in the community in Marin County, California by conducting in-depth qualitative interviews with PWUD who were formerly incarcerated about their past experiences with and policy preferences for MOUD treatment.

Methods

Study Setting

Marin County is located in the San Francisco-Bay Area in California and has a population of 262,321 [44]. Marin County is often ranked as the healthiest county in California [45], and has a median household income of $121,671, ranking within the top 10 wealthiest counties in the US [46]. Although Marin has a high overall ranking on most indicators of health and wellbeing, it also has the second highest racial and ethnic disparities, on average, in health care access, crime and justice, education, housing, and economic opportunity compared to other counties in California

[47]. Mirroring national trends, Marin County experienced a two-fold increase in drug overdose deaths between 2018 and 2021, from 30 to 62 deaths annually [48].

Participant Recruitment

We used a combination of purposeful maximum variation and snowball sampling to recruit individuals who were accessing services at either a MOUD treatment center or via a harm reduction outreach provider [49]. Individuals met criteria for the study if they self-reported that they were: 1) at least 18 years of age; 2) incarcerated in a jail or prison within the past 5 years; and 3) currently using any type of opioid regularly, have an OUD, or are receiving MOUD. Individuals who met study criteria were invited to participate at the time they were receiving routine MOUD treatment services or in the community while harm reduction providers were conducting active outreach to offer resources. Some participants referred peers to the study after participating. Participants were offered $35 for participating, an amount we came to after consulting with the community of PWUD. The harm reduction provider predominately works with unhoused or precariously housed populations and provides services at fixed sites throughout the week and via active outreach at community sites where people live. Throughout the interviewing process, the team observed the demographics (race/ethnicity, age, sex) of participants recruited into the study and discussed priority groups to reach with site partners to encourage recruitment of a diverse sample. Participants gave verbal consent to participate in study activities. All study procedures were reviewed and approved by the University of Washington's Internal Review Board.

Data Collection

A semi-structured interview guide was developed with input from key stakeholders in California with expertise in jail-based treatment, including the coordinator of a statewide grant program expanding jail-based MOUD, Marin County's Public Health Officer, and Marin County's Chief of Addiction Services, as well as site partners. The guide covered knowledge and preferences of different MOUDs, experiences with MOUD in the community and during incarceration, experiences during incarceration generally, and policy and program preferences for people who use drugs in the community and CLS.

Half of the interviews were conducted electronically via phone or Zoom before in-person research activities were permitted as a result of the Coronavirus 2019 (COVID-19) pandemic. In-person interviews were conducted in one week in Marin County by joining the harm reduction outreach provider during their regularly scheduled community outreach events. Most participants were recruited in Marin City, San Rafael, and Novato. All interviews were conducted by the same person (HH) who was not a service provider at either recruitment site.

Identifying data about study participants were not collected given the sensitive nature of interview content. Two individuals were unintentionally interviewed both electronically and in-person. Audio recordings from both interviews were merged for final analyses. Audio records from all interviews were transcribed by trained transcribers listening to audio recordings three times, as needed, if they encountered unclear audio. Only 2 interview files contained significant redacted information (e.g., full sentences) because of audio quality.

Analysis
Transcribed audio recordings were loaded into NVivo to perform a qualitative data analysis [50]. Thematic analyses consisted of three key components: 1) preliminary code identification, concept definition, and code finalization; 2) iterative coding of participant responses by two independent coders [51]; and 3) enumerating and analyzing presence of final codes by participant attribute. Preliminary code identification was informed by the structure of the interview guide. Code co-occurrences were calculated to identify the centrality of each theme and associations between codes and key barriers to accessing OUD prevention and treatment services in the community and CLS [51–54]. One analyst has lived experience with illicit drug use and is currently taking methadone for OUD and the other was the principal investigator. Themes were stratified by race/ethnicity and gender to identify potential differences in experiences and preferences. Non-white or Hispanic/Latino/a racial and ethnic groups were combined in stratified analyses because of small cell counts and to conceptualize the impact white supremacy had on each theme. A conceptual model was developed to understand how reported barriers to accessing services correlated to policy and program preferences reported by participants (**Figure 1**). The model was developed by grouping topically similar themes into larger categories that captured the underlying forces that influenced each theme. Policy and program preferences that may address barriers reported by participants were paired with each structural category. Both co-analysts reviewed and discussed the conceptual model.

Results
The median age of study participants was 43 (interquartile range (IQR): 34-54). Most participants were white (60%, n=12), male (55%, n=11), not in MOUD treatment currently (70%, n=14), incarcerated within the past two years (60%, n=12), and incarcerated in a jail (90%, n=18). Those in MOUD treatment currently reported use of all three FDA approved MOUDs (suboxone n=3; methadone n=2; naltrexone n=1). Experiences with length of incarceration and reason for arrest varied, with most incarceration events trending towards less than one month, as might be expected for a mostly jail population (**Table 1**).

Experiences among people who use drugs during incarceration
The majority of participants told staff that they were using drugs prior to incarceration (60%, n=12), with most reporting feeling ignored or treated the same as any other inmate after disclosing that information (45%, n=9) and some reporting poor treatment after disclosure (25%, n=5). One participant noted that they did not feel comfortable asking for help while incarcerated because they witnessed people being punished after asking for help:

> "Well I could say that it was a horrible, horrible experience. And oftentimes prisoners are locked up and beat up, physically assaulted by correctional officers for asking for help. Yeah not only not given help but punished for asking for it."

Additionally, most participants noted that OUD treatment options were not discussed at any point during their stay (55%, n=11). People also expressed that they felt they only received medical treatment if it reached a crisis point (30%, n=6) and that they had difficulty receiving medications during incarceration (40%, n=8), including issues with cost of medications within the jail and being able to access and take their prescribed medications during incarceration. The following participant describes how they had to advocate for themselves to receive emergency care during a crisis:

"Well, they barely got me. They would've let me die if I had not demanded to get me to emergency right then, because I was throwing up. I was going to die. I had to demand that they get me there right away and they did, but I had to ask."

Nearly a third of people (30%, n=6) reported receiving MOUD while incarcerated either through treatment inductions or to treat opioid withdrawal, and many said addiction classes were available in their correctional facility (45%, n=9), but that they were usually abstinence-based or focused on alcohol, as described by a participant below (**Table 2**).

"At best, there would be a couple [Alcoholics Anonymous] meetings here and there, at best. Nothing medical."

Many participants reported several feelings and fears because of the poor treatment of PWUD during incarceration (**Table 3**). People expressed concerns about incarceration feeling dehumanizing (40%, n=8), including feeling "caged like an animal," and leaving them feeling powerless or hopeless (25%, n=5). The majority of people also reported feeling ignored or like staff did not care about their wellbeing while incarcerated (70%, n=14). These experiences also resulted in PWUD feeling like their life was not valued (15%, n=3) and that the system set them up to fail (15%, n=3).

Experience of Opioid Withdrawal during Incarceration

Most participants encountered opioid withdrawal while incarcerated (55%, n=11), the majority of whom said they were not offered medical support (50%, n=10). Some people noted that they were offered comfort care medications for things like nausea (30%, n=6), and only two participants reported that they were offered buprenorphine or methadone for withdrawal treatment (10%). The majority of the study sample expressed beliefs that someone would experience feelings of self-harm when experiencing untreated drug withdrawal (75%, n=15), with 35% (n=7) of individuals saying they experienced a desire to self-harm personally during these experiences. A quarter (30%, n=6) of participants reported being treated poorly by staff when experiencing withdrawal, including being laughed at or physically harmed. Several (n=4) individuals expressed fears of disclosing that they're experiencing feelings of wanting to harm themselves or withdrawal for fear of being put in solitary confinement (**Tables 2 and 3**).

"…you don't want to get locked down in this little room…in general, you don't tell a guard that you feel sad or you just feel depressed or anything like that at all because you're scared to because they're gonna lock you down..."

Experiences with Drug Use in the Community

Many participants expressed fears of fentanyl contaminating the drug supply (40%, n=8) and feeling afraid of death when using drugs (25%, n=5 (**Table 2**).

"It's almost seeming like death is more the option that's happening more and more frequently, and it's not a matter of if, it's a matter of when. So, I think that that knowledge changed things"

In some cases, participants explicitly mentioned seeing many fentanyl overdoses in the community (20%, n=4) and reviving overdoses among their peers, sometimes with several naloxone doses needed.

> "Yeah. It's just like, I need to stop, you know? And then I also remember I've seen people I know that just passed away like four or five days ago just right over here, over injecting"

This fear of fentanyl contamination also led to feelings of resentment for not having access to a safe supply of drugs and becoming dependent on a drug they did not intend to use.

> "I'm resentful because I didn't set out to become a fentanyl addict… But see, I'm wondering now… if maybe it was because it was in my dope anyway, that I didn't somehow get used to it… I did not sign up for that at all. But I have free will, right? I don't have to do it… I feel like an idiot. But on the other hand, I feel kind of shut up. The only thing that changed in my life was that they had started putting that crap in the dope I was choosing to do."

These experiences witnessing an overdose led some to report using drugs alone because they were fearful of losing a peer.

> "I stopped going around people entirely for, I don't know, almost a year because every time I do I've got to have [naloxone] on me because… somebody was going to try to die right there in front of me. It was happening so much."

MOUD Treatment Preferences or Beliefs

Most participants expressed a concern that using medications to treat an OUD "trades one addiction for another" (55%, n=11), including a mixture of people who felt that it reinforced a physical dependency to drugs and some expressing a lack of trust in pharmaceutical and medical institutions, citing their desire to make money as the primary driver of this mistrust. Many supporting quotes showed a preference for abstinence as the ultimate and singular goal of treatment.

> "… a lotta people look at methadone and Suboxone as still a substance. You can get high on it. So they don't necessarily think you're clean, but you're not clean-clean. You know what I mean?"

> "I think it's a good idea in concept but the way it's practiced ain't the way it should be from what I've seen. That was my opinion anyways, I guess. It's more like they're just trading one drug for the other and it's more of a – just a cash machine, it's mostly just about money."

Despite these sentiments, 60% (n=12) were supportive of using MOUD. The most commonly supported MOUD was buprenorphine (35%, n=7), often described as the brand name product Suboxone, followed by naltrexone (20%, n=4), then methadone (15%, n=3). Some participants expressed concerns that methadone was more addictive than other opioids (25%, n=5), may still provide a high (20%, n=4), and is potentially difficult to taper down from when discontinuing MOUD (30%, n=6).

> "I mean they were just as addicted and suboxone and the methadone is just as bad as the heroin when they try to come off and if they don't do it right that'll kill 'em too… and the addiction to it is, like I said, just as strong if not stronger than the heroin."

In contrast, those who supported methadone said they felt it reduced cravings or drug use (20%, n=4) (**Table 3**).

> "Methadone is fairly safe and lower dose, and it gets rid of the cravings and all that. And you can't really go wrong with it. I think it's pretty successful in that area. Suboxone I've seen people that react really strongly to it and have horrible reactions to it."

The sentiment of not being on MOUDs in perpetuity extended to the opioid antagonist, naltrexone, with this participant also noting concerns about the side effects they feel when missing a dose:

> "…right now I'm working my way off naltrexone. I'm now currently taking half tablets. And the thing is I noticed it when I don't take, like if I forget to take a pill, right, I'll get a headache or else, or I'll feel funny. You know, so but I know it's time. I mean it's just like anything else. I don't want to depend on that to survive."

Barriers to accessing services in the jail and community

Participants reported barriers that fell into several different broad categories: 1) Fear and mistrust of authoritative powers (e.g., correctional officers, service providers); 2) Violence against the community; 3) Stigma; 4) Drug use meeting an otherwise unfulfilled emotional or social need; 5) Interest in treatment; 6) Structural forces (e.g., discrimination, accessibility); 7) Logistics; 8) Availability (**Figure 1, Table 4**).

People reported significant discrimination against those who use drugs or have mental health conditions (55%, n=11). One participant noted how this made them feel:

> "When… you're smiling and wave at somebody and they just turn their nose up and say nothing to you, or… you – like, you forgot your wallet and you really need that dollar, five bucks for gas, and you're not gonna make it, that's how you feel but a little bit lower… Like you feel ashamed. It makes you feel like you know that they're not better than you, but yet they feel like they are."

This discrimination generally led to a breakdown of trust in service providers, and fear that PWUD may be hurt or not believed if they seek help.

Participants also said they felt they only had so many chances with service providers, citing times they had lost services in the past by missing an appointment, violating punitive rules, or not behaving "the right way" for providers.

> "When I was in a program… I dropped a mirror on my foot, and I had stitches in my toe and just so much pain, and they gave me Vicodin. I could not wait until the next day to take one. I took one, and they threw me out of the program, even though I brought everyone back and told them that I had to take the one. This is where the laws have to change."

Another participant noted that they took methadone during a pregnancy to treat their OUD, but when their child was born with physical opioid dependence, a child protective services case was opened against them. Experiences of violence from service providers or in the jail also contributed to this lack of trust, with several participants noting abuse or physical violence while incarcerated and feeling that they were punished for not having a house.

Many people cited stigma against PWUD in the community, medical settings, and in jail or prison. Participants also cited internalized stigma, including feelings that PWUD are bringing it upon themselves and responsible for the conditions they are experiencing (30%, n=6). Among those reporting that they believed MOUD traded one addiction for another, some expressed externalized stigma against PWUD by describing a desire to distance themselves from "bad drug users." This stigma led some to reporting feeling that if they were going to be stigmatized either way, they may as well use drugs (15%, n=3).

Participants noted several key structural forces that contributed to their desire to access services. Several described scenarios where medical providers were complicit with conditions in the CLS. One participant describes their experience telling correctional officers they were experiencing withdrawal and being told to wait for the nurse only to find help was still not provided:

> "She says, "Have you been with your medication in the next 30 days?" And I was like, "Well, no. I've been out in my addiction." "Well, we can't give you nothing, so you have to put a slip in for the doctor." Okay. I gotta go upstairs, request an appointment, and that could be two days. Meanwhile, I'm vomiting and getting sick, you know, and then they tell you to stop… and the nurse says, "She's fine. She just has an upset stomach." Unless you're really like, having seizures, then they do something."

Several other people described discrimination against minority and immigrant populations, noting how the harms against PWUD are even more prevalent in these populations. This participant describes how it feels to live within a structurally racist system:

> "If you're a minority, we're already screwed 'cause Black lives don't matter. Death matters, and dying unnecessarily, that's the shit that people are pissed off about. That's what matters. But we've all known, and even my generation, especially now, that like the quality of life of African Americans in America has always been really, really horrible, and now it's even less. They have less life expectancy than before Civil Rights, and the social stigmata [that] is in the workplace and the educational system and in financial situations is really, really painful."

Many logistical challenges were reported, including factors like cost, discontinuation of treatment due to moving or incarceration, and issues with transportation. A common theme was how difficult it was to initiate treatment in the jail and in the community. One participant noted that their jail lawyers recommended that they go into treatment to offset jail-time, but that it still took three months to get a spot at a treatment center. Another participant who had difficulty getting started on treatment in the jail and the community described how it was easier to continue using drugs than get help:

> "Yeah, it sucks. I mean like the last – I lost a lot of stuff over like the last year over opioids. I just I don't want to keep using it. I really don't want to keep using. I can get off if I can get back home, but I just can't get out of that access to it as easily as I do out here."

Many also noted that they felt the process was purposefully difficult so that people have to prove how badly they wanted services:

> "I felt like, I don't know, maybe they want people to – they wanted to see people really actually trying or something, or see how – I don't know, maybe see how bad somebody

really wanted to get on the program. I don't know. I don't know why they did that. It's really frustrating. I wish they would make it easier."

Program and Policy Preferences in the Jail or Prison

Many suggestions and preferences from participants address the barriers identified above. Most participants expressed a desire for correctional staff to approach them with empathy and a personal connection in jail or prison (60%, n=12), which ties into the theme of feeling that incarceration is dehumanizing. Many participants expressed a desire for provision of support instead of penalization of drug use (45%, n=9), noting how challenging it is to stop drug use and how important supportive, empathic connections are in facilitating acceptance of services (**Table 3**).

> "I mean, whenever you get locked up… you're losing everything that you know… everything that you're used to, all…your crutches... And it all gets shut away, your clothes and all, and then you're pretty much like, boom, you're in this whole new atmosphere. It's a lot different. I mean, they just need to be a little bit more empathy, is how I should put it, for people that's at that level."

Additionally prevalent themes were requests for jails and prisons to provide:

- More counseling or support groups during incarceration (40%, n=8);
- More follow through on connections to treatment upon release (25%, n=5); and
- More medical support generally (25%, n=5).

Several participants noted how difficult it is to transition into the community upon release from jail, and that respectful accountability and warm connections from service providers may have helped them transition to community services more successfully.

> "if they can make the program that whenever the people get out from there, they have somewhere to go or they got like a program set for them or something, you know, 'cause a lotta them people get out, and they don't even got an ID, so they can't even cash their money they had…if they had any"

Differences in experiences and perceptions by race, ethnicity, and gender

A larger proportion of participants who identified as Black, Hispanic/Latino/a, Multiracial, Multiethnic, or Native American expressed themes of self-blame (63%, n=5 vs. 33%, n=4), and witnessing an overdose (63%, n=5 vs. 0%, n=0) as compared to White participants. This theme of self-blame also translated to the perception that people have to suffer to make it to recovery and that compassion may turn into feeling like a martyr, as reported by a participant below:

> "Everything [in] my addict mind was shifted and looking for justification to feel depressed so I can justify using later on. So they don't always give us an opportunity to be a martyr or a victim because my mind would take that opportunity because I could utilize that later in my addiction."

Respondents of color discussed fear/mistrust in the jail or prison (88%, n=7 vs. 67%, n=8) and in the community (75%, n=6 vs. 50%, n=6) more frequently than white respondents. Much of the difference in trust in community providers between these subgroups was driven by people of color mentioning how they felt they only had so many chances with treatment and support services before being terminated or no longer eligible to receive services (63%, n=5 vs. 8%, n=1)

(**Tables 2-4**). The quotes below from two participants describe how it felt when trying to access conditional services:

> "Once you get dropped, you're calling, nobody answers, you know? It's like, "Wait a minute. You were just on my ass about going and doing this, this, and this, and now you're not there." It's like [Narcotics Anonymous]. You know? You go, go, go, and then you have one relapse, and everybody, "Oh, we can't talk to you.""
>
> "They'll give you a chance, and they'll do the SLE, and they'll do the probation and all that stuff with you. But after one or two chances, they're just like, "You're burnt." You just do your time…I was doing it, and then I ended up relapsing. And then when I went to jail – because it was two, three days after – you miss it for a certain amount of days, they just don't give it to you anymore."

Respondents who identify with non-White, Multi-ethnic, or Hispanic/Latina/o racial and ethnic subgroups were also more likely to report stigma against people using drugs (63%, n=5 vs. 17%, n=2), a need to decriminalize drug use (50%, n=4 vs. 8%, n=1), support themes contributing to structural forces causing barriers in accessing services (88%, n=7 vs. 52%, n=5), and support themes related to concerns over fentanyl contamination and their community experiencing many overdoses (**Tables 2-4**). The participant below notes that they feel they are paying the state for having a sickness:

> "And we're still fighting the war on drugs, and I'm gonna make you pay for getting caught because you're sick, and that's what it is. It's a sickness. It's an addiction. It's a sickness. But because I'm working hard to get that drug or hustle to get that drug and you catch me, you're gonna punish me. But of course that, it's like kill or be killed, caught or be, caught or get away with it. So I mean and it's all a damn game. How good are you at it is the question."

Some participants expressed exhaustion with the trauma experienced as a result of criminalization, racist policing practices, and stigma against PWUD.

> **"**Police officers routinely, by methodology, tend to target minority groups or lower-income neighborhoods, and then they also tend to back each other up when – or lie and falsify legal documents whenever one of them does something wrong… what it also does is it creates a society where… a form of, I guess, a terrorist impact on a community, seeing something horrible, witnessing it, making them all victims and traumatic victims of it and losing a member of their community has become the norm and the custom."

Female participants were more likely than males to report feeling like staff did not care about them in the jail (100%, n=9 vs. 46%, n=5), fear/mistrust in jail or prison (89%, n=8 vs. 64%, n=7), and fear/mistrust in the community (89%, n=8 vs. 36%, n=4). These differences may be partially driven by experiences where women felt they only had so many chances with service providers (56%, n=5 among women vs. 9%, n=1 among men) and a breakdown of trust in their community providers (67%, n=6 among women vs. 27%, n=3). This participant describes a scenario in which they felt correctional staff did not care that they were suffering:

> "Well, I feel like they really didn't care at all what was happening to me. I mean they couldn't care less. They didn't give a shit what I was going through, and I was violently ill. Like I was throwing up like so much, I was dry heaving. I was really, really violently

ill. Like I needed some serious help and they just didn't give a shit about me. They didn't care. Like I was throwing up when the deputies – like as I was getting bailed out I was fine after that. I was very sick. Very sick, and they just didn't give a shit. I mean I think one time a deputy came in my cell and was like, "Are you alive," and that was it."

One participant discusses their frustration with community housing services when they were in crisis, and how this experience led to low trust:

"I just see that I become real dysfunctional, and I expected a lot of help. It took me years to admit that I was as messed up as I had become and still that messed up. But they're just not – the companies, services, those people, come on now, this is the best that you can do? It's like, this is the best that you can do?... You've got to be able to do better than this. It totally sucks. I'm grateful to have what I have. But it's only by being tenacious and bullheaded and stubborn. I had to change my whole way. Hopefully those things will change. Hopefully they'll change."

Another participant describes how they felt they were only treated in the hospital if severe because they had been labeled as someone who uses drugs:

"They degrade, humiliate, and perform cruelty. I've gone into the hospital where they immediately said, "Oh, she's an addict. Don't give her any pills," because they read my chart. That should be private information."

Female participants were also more likely to support a desire for service and treatment approaches that leveraged empathy and a personal relationship (89%, n=8 vs. 36%, n=4), witnessing or experiencing violence (67%, n=6 vs. 18%, n=2), a desire for services to meet people where they are in the community (44%, n=4 vs. 0%, n=0), and cost (44%, n=4 vs. 9%, n=1). Men were more likely to support themes of self-blame when using drugs (55%, n=6 vs. 33%, n=3) (**Tables 2-4**). A participant discusses how their experiences witnessing violence during incarceration changed how they felt about asking for or accepting services for their substance use disorder:

"Yeah… people say this is in your head, because you're tweaking or because you're paranoid or whatever, but some of the stuff that all of these people gotta maybe hear, I don't know, it's sometimes true, you know, how they treat you. This one girl was coming off it, and she really didn't wanna get out of the room, and so the deputy took a bucket of water and threw it on her, watched her, like almost – you know how when they go to the zoo and they have the elephants, and you have this smith? That's what the cells are made of, so it reminds me of the cells of the zoo, that's meant like concrete, right?... And she opened the door, and she just threw the water at her in there, and then said, "Get dry." And I'm like, you know, that's just so inhuman. Maybe she couldn't get up… And then that's like, she should be in the hospital or somewhere different, not in jail. Maybe jail, but another part, whatever, you know?"

Several participants described their desire for services to meet people where they live in the community.

"So a lot of people don't – they don't go to the doctors. They're so high, they just – they don't make it passed their tent, you know… they're stuck in a rut, you know. I think there should be a global bus or whatever that reaches out to them, 'cause they don't like to

> reach out to you guys. We have a hard time with that, but I think there should be more outreach, that's what I would like to see."

Discussion

These findings highlight an opportunity to ensure people have access to life-saving medications during incarceration and important gaps in treatment delivery and access within the jail and community. Several modifiable barriers were observed, including logistics such as cost and transportation, stigma against PWUD in correctional settings and the community, a breakdown of trust in service providers generally, and structural forces like discrimination and racism. As we highlighted in this study, some of these barriers may be addressed with interventions suggested by the community themselves, such as decriminalizing drug use, SUD and compassionate care trainings for correctional officers, having alternative types of service providers with expertise that may better meet inmates' medical and social needs (including those who have lived experience with drug use), meeting people where they are in the community, and providing more social supports like housing.

Half of participants said they did not receive any kind of medical support for withdrawal. There are several options for treating opioid withdrawal, with best practice being to focus on the patient's treatment goals. Shared decision making about MOUD with incarcerated people has been shown to significantly increase the likelihood of starting medications upon release and models of care navigation for those involved in the CLS system to be connected to MOUD have been described previously [55,56]. Opioid agonist treatment with methadone and buprenorphine is considered to be the gold-standard [57]. Experiences with untreated opioid withdrawal during incarceration have been reported in other studies, including the sentiment we observed in our study that care was only received if it the withdrawal was perceived as severe [14,33]. These experiences not only change how people feel about treatment due to a fear of experiencing untreated withdrawal during incarceration if they initiate MOUD in the community [13,14], but also contribute to suicidal ideation. Over a third of participants in our study said they experienced feelings of self-harm when going through untreated withdrawal from opioids, with few reporting these experiences to correctional officers for fear of being put in solitary confinement.

Experiences that discourage inmates from expressing their feelings of self-harm may hinder people who use drugs and those with mental health conditions from reporting their medical needs to correctional staff, ultimately resulting in delayed or never delivered treatment. At worst, these experiences could lead to an increased risk of individuals ending their life while incarcerated. A recent meta-analysis reported that the odds of self-harm in prison was 14 times higher among prisoners that had current or recent suicidal ideation (odds ratio [OR]: 13.8, 95% confidence interval [CI]: 8.6-22.1). In fact, solitary confinement, which participants noted was the response to suicidal ideation while incarcerated, was identified as a significant prison-specific environmental risk factor that increased the likelihood of self-harm (OR: 5.6; 95% CI: 2.7-11.6) [58]. These types of barriers likely contribute to an increased risk of death and overdose both during and after incarceration [59]. An environment that discourages reporting of feelings of self-harm not only misses an important care delivery opportunity for a vulnerable population, but also goes against standards of care in the community for people experiencing suicidal ideation [60]. Although few studies focus on jail populations specifically, a recent meta-analysis found that occupation of a single cell and having no social visits during incarceration were associated with

suicide risk in prison [61]. These factors as well as provision of appropriate medical care for PWUD, particularly those who experience withdrawal, are institutional policies that could be implemented to reduce deaths. Given the high prevalence of co-occurring mental health and substance use disorders among people who become incarcerated, jails and prisons should closely monitor use of solitary confinement for all inmates, routinely screen for suicidal ideation openly and without punishment, and implement safer policies for treatment of people who use drugs and express suicidal ideation.

Many participants expressed fear of death due to fentanyl contamination, and how this has changed some of their drug use habits. Some respondents reported beginning to use drugs while they were alone, which increases the risk of overdose death. A British Columbia study found that 76% of PWUD accessing harm reduction supplies used drugs alone in the past week, the primary reason being for convenience and comfort [62]. Our study identified another potential way fentanyl contamination may be increasing overdose risk. These issues may be addressed through efforts to provide the community of people who use drugs with information about what's in their drug supply, such as fentanyl test strips, comprehensive drug checking with spectroscopy, and drug contamination alerts, and to identify underlying sources of contamination so they can be removed before entering the illicit drug supply [63]. In this study, 2 respondents (10%) reported unknowingly ingesting fentanyl during incarceration, while others reported that fentanyl is cheaper than heroin in the community (n=3; 15%) and people are starting to use fentanyl instead of other drugs (n=3, 15%). Research suggests that although fentanyl overdoses occurring in correctional facilities are often not reported, they are likely occurring at an increasing frequency [64]. Given the increase in fentanyl use in the community and within the illicit drug supply in correctional institutions, jails and prisons should implement widespread naloxone availability, increase knowledge of fentanyl and overdose risk among correctional staff, and expand access to MOUD to prevent further harm [64]. Given misplaced fears about unintentional exposure to fentanyl among those caring for PWUD, accurate information about the negligible environmental exposure risks should be provided to correctional staff [65].

Respondents identifying with a non-white, multi-ethnic, multi-racial, or Hispanic/Latino/a racial or ethnic subgroup supported themes that suggested they were experiencing more significant trauma or discrimination as a PWUD than white respondents. Themes of self-blame and a reliance on willpower were more common among respondents of color. Similar themes were supported in another qualitative study among people of color who use drugs [14]. Media coverage during the emergence of the overdose epidemic largely portrayed people who use drugs who are Black or Hispanic/Latino/a as criminals while those who were white were portrayed more sympathetically [66]. The media reflects sentiments of "mainstream" society, so is merely shining a light on racism baked into medical, criminal legal, and community systems that result in preferential treatment of white Americans. Our findings suggest this discrimination, racism, and stigma has also contributed to how people of color feel about themselves and their recovery. Respondents of color were more likely than non-Hispanic, white participants to report witnessing an overdose and their community experiencing frequent fentanyl overdoses. Witnessing and experiencing overdoses causes significant trauma among PWUD [67], and in this study, we found that it can also lead to people adjusting their drug use habits. These experiences may contribute to observed inequities in treatment initiation and outcomes among racial and ethnic minorities in the United States [68–70], differences which increase the risk of death for people of color who use

opioids and are incarcerated [38]. Racism is a public health crisis, and structural factors designed to benefit white Americans along with culturally competent care should be considered when conducting outreach to PWUD to prevent further harm and ensure equitable delivery of and access to services.

This study has several limitations. We recruited people already engaged in services through harm reduction and treatment providers. This may have resulted in more favorable perceptions towards treatment or MOUD. Despite this concern, 70% of participants were not receiving MOUD and we identified several barriers among people who were largely not routinely accessing services other than needle exchange. Additionally, the majority of those recruited into our study were white, non-Hispanic, and cis-gender. Our stratified results by race and ethnicity suggest greater harms and meaningful differences in these experiences and preferences among Black/African American, Native American, Hispanic/Latino/a, multiracial, and multiethnic communities. Our study was not powered to detect many differences in themes between these racial and ethnic groups, and some themes or experiences unique to other racial and ethnic groups as well as among transgender PWUD may not be reflected. Conducting the study in English may have also missed important preferences among those who speak Spanish, which is 12% of Marin County's overall population [46]. Lastly, this study was conducted in Marin County, California, meaning preferences and experiences in this county may not translate to other settings. However, we did identify several key barriers and experiences that have been documented in other settings among PWUD, suggesting some themes capture a common experience.

Our study also has several strengths. This project is the first study in Marin County, California among PWUD and are formerly incarcerated, providing a foundation for the county to continue building support networks for PWUD to be involved in policy and program development. This study also serves as one of the first studies in the literature specifically focused on CLS and MOUD-specific experiences, policies, and programs among PWUD. Additionally, we built a diverse team of researchers and site partners who had lived experience with incarceration, an OUD, and MOUD with the goal of ensuring the perspectives of PWUD were centered throughout the research process. Additionally, by collaborating with harm reduction and treatment partners for recruitment, the team leveraged trusted relationships between PWUD and their providers to build comfort among those participating, following recommended practices from similar research [71]. This collaboration also allowed for an independent interviewer with no connection to either service to conduct the interviews, which may have reduced social desirability bias. Semi-structured interviews allowed for people to express their experiences with their own words and structured questions allowed for meaningful summaries on key topics.

Correctional institutions have a mandate to assure equivalence of care between those who are incarcerated and those living in the community [72], and in 2022, the Department of Justice issued guidance indicating that disallowing access to MOUD is a violation of the Americans with Disability Act [73]. The CLS is an important partner in providing a holistic approach to address OUDs. Prior research from Michigan found that those reporting pre-sentence daily opioid use had a higher risk of death, and that probation supervision significantly reduced the risk of overdose death [74]. Many have also called for care to be delivered outside of the CLS for those arrested on non-violent or drug-related charges, calling for decriminalization of drug use as a matter of equity and justice [75,76]. This study aimed to assess PWUDs preferences towards MOUD

treatment policies in Marin County with the goal of integrating their feedback into local policies. A future direction of this work may be the development of a structured framework for PWUD to not only provide feedback on, but participate as leaders in policy development and implementation [40]. Given the high prevalence of opioid use among people incarcerated, at minimum, investing in continuity of care between the community and the criminal legal system is invaluable in reducing OUD-related harms [77].

Acknowledgements

This research would not have been possible without the support of site partners, including Dominique McDowell, Chris Brown, and Andy Fyne. This research was funded by the National Institutes of Justice Fellowship in the Social and Behavioral Sciences administered by the United States Department of Justice (2019-R2-CX-0006) and the University of Washington Magnuson Scholarship.

Figure 1. *Conceptual model of barriers to accessing services and proposed solutions among people who use drugs and were formerly incarcerated – Marin County, California*

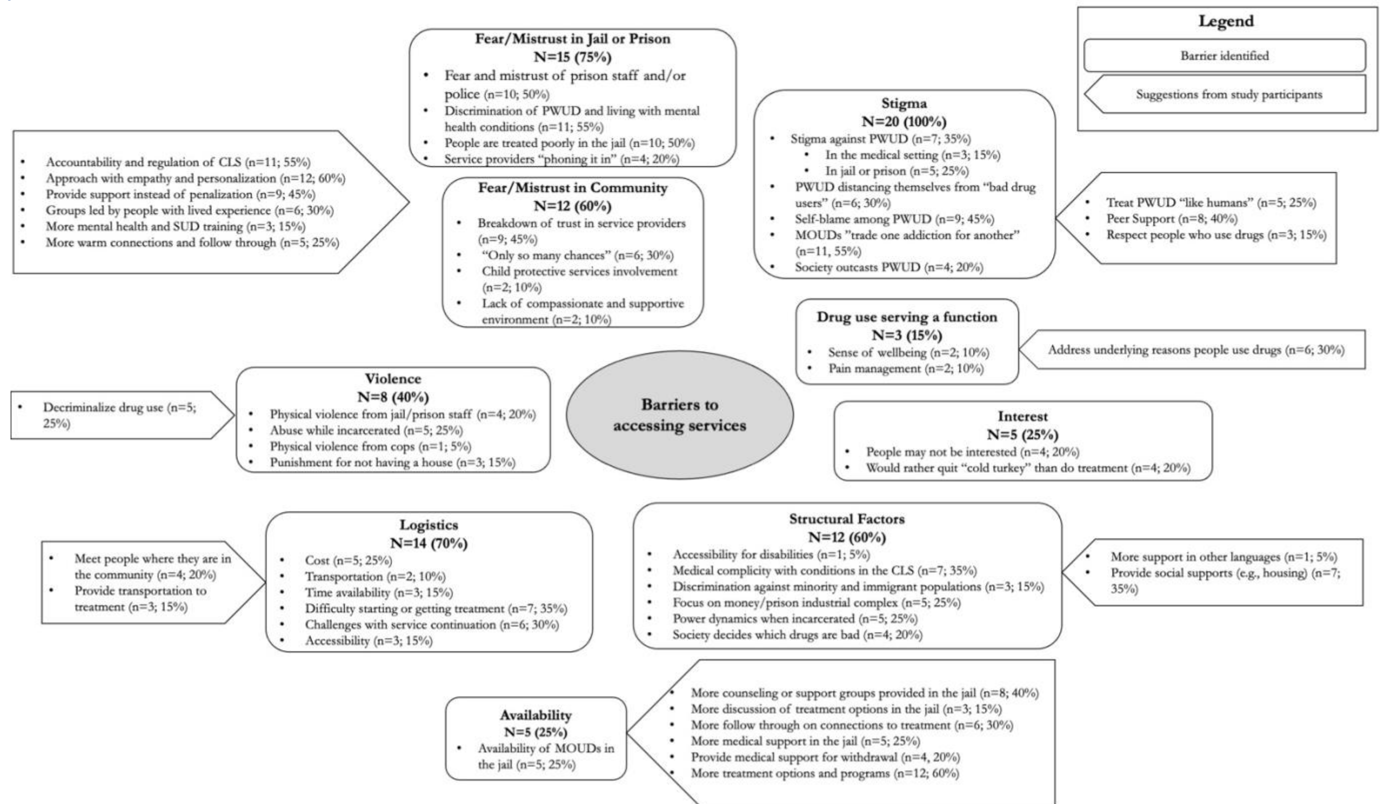


Table 1. *Characteristics of Study Sample*

Attribute	N	(%)
Recruitment Site		
OUD Treatment Center	3	(15)
Harm Reduction Outreach	17	(85)
Interview Format		
Electronic (phone or Zoom) Only	10	(50)
In-person Only	8	(40)
In-person and Electronic[a]	2	(10)
Race/Ethnicity		
American Indian/Alaskan Native	2	(10)
Black/African American	2	(10)
Hispanic/Latinx	2	(10)
Multi-racial, Multi-ethnic	2	(10)
White	12	(60)
Median Age, IQR	43 (34-54)	
Gender		
Male	11	(55)
Female	9	(45)
Self-Reported OUD Treatment		
Buprenorphine	3	(15)
Naltrexone	1	(5)
Methadone	2	(10)
Not in Treatment	14	(70)
Last incarceration event		
Less than a month ago	1	(5)
Between 1-5 months ago	2	(10)
Between 6 months-1 year	1	(5)
Between 1-2 years ago	8	(40)
More than 2 years ago	8	(40)
Most Recent Incarceration setting		
Jail	18	(90)
Prison	2	(10)
Length of Most Recent Incarceration		
Less than a day	2	(10)
1 day to 1 week	4	(20)
More than a week to 1 month	6	(30)
2-6 months	3	(15)
6 months to 4 years	4	(20)
5+ years	1	(5)
Reason for Incarceration[b]		
DUI/Public Intoxication	2	(10)
Drug possession	6	(30)
Drug sales	2	(10)
Suspended license	1	(5)
Illegal weapon possession	2	(10)
Illegal camping	1	(5)
Failure to appear for court	6	(30)
Assault with a deadly weapon	1	(5)
Drug paraphernalia	2	(10)
Theft	2	(10)

[a]Individuals recruited in-person and later confirmed to have been repeat interviewees.
[b]Information unavailable for 2 interviewees (17%). Some interviewees may have more than one reason for incarceration, so categories are not mutually exclusive.

Table 2. *Selected themes from experiences and preferences for treatment during incarceration among people with an opioid use disorder who were formerly incarcerated — Marin County, California (N=20)*

Themes	All Respondents N=20		Race/Ethnicity[b] Non-White, Multi-ethnic, or Hispanic/ Latina/o N=8		White, non-Hispanic/ Latina/o N=12		Gender Female N=9		Male N=11	
	n (%)[a]		n (%)		n (%)		n (%)		n (%)	
Experiences while Incarcerated										
Told correctional officers or other staff that they were using drugs	12	(60)	4	(50)	8	(67)	5	(56)	7	(64)
Ignored or no difference after disclosure	9	(45)	3	(38)	6	(50)	4	(44)	5	(45)
Treated poorly after disclosure	5	(25)	3	(38)	2	(17)	3	(33)	2	(18)
Some correctional staff were kind	5	(25)	2	(25)	3	(25)	3	(33)	2	(18)
Lots of availability of drugs in prison and jail	6	(30)	2	(25)	1	(8)	2	(22)	4	(36)
Had to wait or did not receive prescribed meds in jail	8	(40)	4	(50)	4	(33)	4	(44)	4	(36)
Had to wait to receive MOUD	4	(20)	3	(38)	1	(8)	2	(22)	2	(18)
Prescribed medications expensive in jail	3	(15)	1	(13)	2	(16)	2	(22)	1	(9)
Imbalance of power dynamics between correctional officers and inmates when incarcerated	5	(25)	3	(38)	2	(17)	3	(33)	2	(18)
Physical or emotional abuse while incarcerated	5	(25)	3	(38)	2	(17)	3	(33)	2	(18)
People are treated poorly in jail or prison	10	(50)	4	(50)	6	(50)	6	(67)	4	(36)
Withdrawal Experiences during Incarceration										
Experienced feelings of self-harm personally when going through withdrawal	7	(35)	2	(25)	5	(42)	3	(33)	4	(36)
Did not experience feelings of self-harm personally when going through withdrawal	5	(25)	1	(13)	4	(33)	2	(22)	3	(27)
Experienced opioid withdrawal while incarcerated	11	(55)	5	(63)	6	(50)	7	(78)	4	(36)
Not offered medical or other support when going through withdrawal	10	(50)	5	(63)	5	(42)	6	(67)	4	(36)
Not offered buprenorphine or methadone when going through withdrawal	7	(35)	3	(38)	4	(33)	3	(33)	4	(36)
Offered buprenorphine or methadone	2	(10)	1	(13)	1	(8)	1	(11)	1	(9)
Offered comfort care medications	6	(30)	1	(13)	5	(42)	3	(33)	3	(27)
Treated poorly by staff when experiencing withdrawal	6	(30)	3	(38)	3	(25)	3	(33)	3	(27)
Drugs sold outside medical system to people with withdrawal symptoms	2	(10)	1	(13)	1	(8)	0	(0)	2	(18)
Adjustment of drug use to avoid withdrawal pain	5	(25)	3	(38)	2	(16)	1	(11)	4	(36)
Treatment experiences during Incarceration										

No discussion of treatment options or preferences during incarceration	11	(55)	4	(50)	7	(58)	6	(67)	5	(45)
Treatment discussed during incarceration	9	(45)	3	(38)	6	(50)	4	(44)	5	(45)
Treatment information provided upon release	5	(25)	0	(0)	5	(42)	1	(11)	4	(36)
MOUD mentioned or offered	5	(25)	2	(25)	3	(25)	3	(33)	2	(18)
Received MOUD while incarcerated	6	(30)	2	(25)	4	(33)	2	(22)	4	(36)
Addiction treatment classes available	9	(45)	5	(63)	4	(33)	3	(33)	6	(55)
Felt they were only treated if severe	6	(30)	4	(50)	2	(17)	4	(44)	2	(18)
Experiences with Opioid Use										
Experienced a lot of loss	4	(20)	2	(25)	2	(17)	2	(22)	2	(18)
Concern with fentanyl contamination	9	(45)	6	(75)	3	(25)	3	(33)	6	(55)
Community experiencing a lot of fentanyl overdoses	5	(25)	4	(50)	1	(8)	3	(33)	2	(18)
Fear of death when using drugs	6	(30)	2	(25)	4	(33)	4	(44)	2	(18)
Self-medication	7	(35)	4	(50)	3	(25)	3	(33)	4	(36)
People self-medicate with methadone	5	(25)	3	(38)	2	(16)	1	(11)	4	(36)
Quitting a substance without help is challenging	6	(30)	3	(38)	3	(25)	1	(11)	5	(45)
Witnessed an overdose	5	(25)	5	(63)	0	(0)	3	(33)	2	(18)

[a]All percentages are based on column totals.
[b] Responses aggregated due to small sample size and to comment on white supremacy and structural racism. Distribution of disaggregate racial and ethnic identities for non-White or Hispanic/Latino/a respondents are in Table 1.

Table 3. *Consequences of negative experiences with stigma and discrimination among people who use drugs and who were formerly incarcerated — Marin County, California (N=20)*

Theme	**Supportive quotes**	**All Respondents N=20**		**Race/Ethnicity[b]** Non-White, Multi-ethnic, or Hispanic/ Latina/o N=8		**Race/Ethnicity[b]** White, non-Hispanic/ Latina/o N=12		**Gender** Female N=9		**Gender** Male N=11	
		n	**(%)[a]**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Dehumanization of incarceration	"You're not treated like a person. You're a number. You're an entity… the bottom line is I think it's like maybe, maybe it's like $70,000 or $80,000 that they get for me to house me every year, so I'm a pay number. That's it. But I'm cattle. Move it along."	8	(40)	4	(50)	4	(33)	4	(44)	4	(36)
Fear of solitary confinement for withdrawal or mental health symptoms	"I mean, also if some people in there who are suicidal, they throw 'em in the rubber room, which is counterproductive of what they're supposed to be doing. They throw 'em in the rubber room, and they strip 'em butt naked and they throw 'em into a rubber room. There's only a hole in the… ground, and they leave you there for plenty of days, and I mean, the light's always on. They don't turn it off. I mean, what else is there to say on that?"	4	(20)	1	(13)	3	(25)	1	(11)	3	(27)
Felt ignored or like staff didn't care about them	"They really didn't seem to give a [crap] really. They were basically obligated to do something, and they did the bare minimum what they had to do… I didn't feel like they were making any special like efforts for anybody, not at all."	14	(70)	5	(63)	9	(75)	9	(100)	5	(46)
Felt life was not valued	"a lot of people believe… that if they just get rid of us, the problem will go. So, they try to eliminate us, but it doesn't matter if it's by death or not. They just want us gone."	3	(15)	1	(13)	2	(17)	1	(11)	2	(18)
Felt powerless or hopeless when incarcerated	"And 99 percent of the people I've seen in prison, they do want to do better, they do want to change, you know, what I mean, but they just feel like hopeless and they know what's gonna happen when they get out, they're just gonna get kicked out, they're gonna get sent back to the same community or the same kind of place they're in and just the same thing over and over again."	5	(25)	1	(13)	4	(33)	2	(22)	3	(27)

Feel system sets them up to fail	"Otherwise, if you send a person out of jail who's been in jail locked up against their will out and have them have to search out all these places and things and people that's an unrealistic expectation. I mean, you're going to get some people that are going to do it that have really strong support systems."	3	(15)	2	(25)	1	(8)	1	(11)	2	(18)
Self-blame when using drugs	"I kind of look at it like I kind of done the dumb [crap]… I kind of put myself in that predicament anyway, so I can't blame nobody but myself. Not saying that I should've got treated with the stuff that I did, but at the same time, that it didn't really matter to them or – and I guess it mattered to me, but it didn't make a difference whether it did or not. I mean, for real."	9	(45)	5	(63)	4	(33)	3	(33)	6	(55)
Feel that MOUD trade one addiction for another	"I think it's a good idea in concept but the way it's practiced ain't the way it should be from what I've seen. That was my opinion anyways, I guess. It's more like they're just trading one drug for the other"	11	(55)	6	(75)	5	(42)	5	(55)	6	(55)
Feel isolated or would like more social connections	"A lot of us don't have family to reach out to. You know, we'd like somebody to reach out to us"	3	(15)	1	(13)	2	(16)	3	(33)	0	(0)
Stigma led to feelings they may as well use drugs	"But then somebody gets pushed around and forgotten about then no, it's like, why would I do it? Nobody cares about me"	3	(15)	1	(13)	2	(16)	2	(22)	1	(9)

[a]All percentages are based on column totals.

[b]Responses aggregated due to small sample size and to comment on white supremacy and structural racism. Distribution of disaggregate racial and ethnic identities for non-White or Hispanic/Latino/a respondents are in Table

Table 4. *Selected themes of medications for opioid use disorder treatment preferences, policy and program preferences, and barriers to accessing services among people with an opioid use disorder who were formerly incarcerated — Marin County, California (N=20)*

Themes	All Respondents N=20		Race/Ethnicity[b] Non-White, Multi-ethnic, or Hispanic/ Latina/o N=8		White, non-Hispanic/ Latina/o N=12		Gender Female N=9		Male N=11	
	n	(%)[a]	n	(%)	n	(%)	n	(%)	n	(%)
MOUD Treatment Preferences and Beliefs										
Supportive of using MOUD	12	(60)	4	(50)	8	(67)	6	(67)	6	(55)
Likes Suboxone (buprenorphine formulation)	7	(35)	2	(25)	5	(42)	3	(33)	4	(36)
Likes Subutex (buprenorphine formulation)	2	(10)	0	(0)	2	(16)	1	(11)	1	(9)
Buprenorphine made it easier to stop using other opioids	4	(20)	2	(25)	2	(16)	2	(22)	2	(18)
Does not like buprenorphine	2	(10)	1	(13)	1	(8)	0	(0)	2	(18)
Concern with buprenorphine side effects	6	(30)	2	(25)	4	(32)	2	(22)	4	(36)
Likes methadone	3	(15)	1	(13)	2	(16)	1	(11)	2	(18)
Methadone reduced cravings or drug use	4	(20)	2	(25)	2	(16)	2	(22)	2	(18)
Does not like methadone	5	(25)	1	(13)	4	(32)	3	(33)	2	(18)
Concerned that it is hard to get off methadone	6	(30)	4	(50)	2	(16)	1	(11)	5	(45)
Believes methadone is more addictive than other opioids	5	(25)	2	(25)	3	(25)	1	(11)	4	(36)
Concerns with methadone dose being too high	3	(15)	2	(25)	1	(8)	2	(22)	1	(9)
Perception methadone may still provide a high	4	(20)	1	(13)	3	(25)	1	(11)	3	(27)
Likes naltrexone	4	(20)	1	(13)	3	(25)	1	(11)	3	(27)
Does not like naltrexone	2	(10)	0	(0)	2	(16)	2	(22)	0	(0)
Not aware of naltrexone	4	(20)	1	(13)	3	(25)	3	(33)	1	(9)
Desire for tapering MOUD doses	4	(20)	3	(38)	1	(8)	2	(22)	2	(18)
Have to have a willingness to engage in treatment	9	(45)	6	(75)	3	(25)	6	(67)	3	(27)
Policy and Program Preferences										
Support for harm reduction services	11	(55)	5	(63)	6	(50)	5	(56)	6	(55)
Safe supply or injection sites	5	(25)	3	(38)	2	(16)	1	(11)	4	(36)
Support for needle exchange	4	(20)	1	(13)	3	(25)	2	(22)	2	(18)
Support for fentanyl test strips	2	(10)	1	(13)	1	(8)	1	(11)	1	(9)
Discuss drug use in schools	3	(15)	1	(13)	2	(16)	0	(0)	3	(27)
More treatment options for people who use drugs other than opioids	4	(20)	0	(0)	4	(33)	2	(22)	2	(18)
Provide MOUD coupled with counseling	5	(25)	3	(38)	2	(16)	3	(33)	2	(18)

Positive regard for local treatment programs	9	(45)	4	(50)	5	(42)	5	(56)	4	(36)
Decriminalize drug use	5	(25)	4	(50)	1	(8)	2	(22)	3	(27)
Provide support for the person and their experience instead of penalization	9	(45)	4	(50)	5	(42)	6	(67)	3	(27)
Peer support	8	(40)	4	(50)	4	(33)	5	(56)	3	(27)
Meet people where they are in the community	4	(20)	2	(25)	2	(16)	4	(44)	0	(0)
Approach with empathy and personalization	12	(60)	5	(63)	7	(58)	8	(89)	4	(36)
More warm connections to services and follow through	5	(25)	3	(38)	2	(16)	4	(44)	1	(9)
Barriers to Accessing Services[c]										
Structural Forces	12	(60)	7	(88)	5	(42)	5	(56)	7	(64)
Medical complicity with conditions	7	(35)	4	(50)	3	(25)	3	(33)	4	(36)
Availability	5	(25)	2	(25)	3	(25)	3	(33)	2	(18)
Logistics	14	(70)	7	(88)	7	(58)	7	(78)	7	(64)
Cost	5	(25)	3	(38)	2	(16)	4	(44)	1	(9)
Violence	8	(40)	4	(50)	4	(33)	6	(67)	2	(18)
Physical violence from jail/prison staff	4	(20)	2	(25)	2	(16)	2	(22)	2	(18)
Fear/Mistrust in Jail or Prison	15	(75)	7	(88)	8	(67)	8	(89)	7	(64)
Fear/Mistrust in Community	12	(60)	6	(75)	6	(50)	8	(89)	4	(36)
Only so many chances with treatment and support services	6	(30)	5	(63)	1	(8)	5	(56)	1	(9)
Breakdown of trust or suspicion of service providers	9	(45)	4	(50)	5	(42)	6	(67)	3	(27)
Interest	5	(25)	2	(25)	3	(25)	2	(22)	3	(27)
Drug use serving a function	3	(15)	2	(25)	1	(8)	1	(11)	2	(18)
Stigma	20	(100)	8	(100)	12	(100)	9	(100)	11	(100)
Stigma against people who use drugs	7	(35)	5	(63)	2	(17)	4	(44)	3	(27)
Society outcasts people who use drugs	4	(20)	3	(38)	1	(8)	1	(11)	3	(27)

[a]All percentages are based on column totals.

[b] Responses aggregated due to small sample size and to comment on white supremacy and structural racism. Distribution of disaggregate racial and ethnic identities for non-White or Hispanic/Latino/a respondents are in Table 1.

[c]Not all subthemes for each barrier are listed in this table. Refer to Figure 1 for the prevalence of other factors.

AIM 2: TEST THE IMPACT OF JAIL-BASED MEDICATION FOR OUD TREATMENT POLICIES ON COUNTY-LEVEL OPIOID-RELATED EMERGENCY DEPARTMENT VISITS, HOSPITALIZATIONS, ARRESTS, CONVICTIONS, AND FATAL OVERDOSES IN CALIFORNIA

Introduction

There is an epidemic of opioid misuse and dependence, resulting in a high-burden of opioid-related harms, crime, and costs to the health and criminal legal systems. Approximately 2.7 million people ages 12 and older in the US had an opioid use disorder (OUD) in 2020, defined as compulsive, prolonged use of opioids without a medical need.[16,78(p5)] Those with an OUD are more likely to have a history of involvement in the criminal legal system (CLS) through arrests or incarcerations than those without an OUD; 51% of individuals with an OUD involving prescription opioids and 77% of those using heroin reported lifetime involvement with the CLS.[3] Moreover, from 2007-2009, 17% of state prisoners and 19% of jail inmates reported regularly using heroin and other opioids, both of which increased significantly from prior estimates in 2002 and 2004, respectively.[17] There is a high burden of opioid use and OUDs among those interfacing with the CLS, resulting in many national and international calls to offer OUD treatment options within this system.[4–6,18–20]

Those with an OUD have many contacts with the CLS through arrests, incarcerations, and the court system, offering opportunities to provide treatment and prevent future fatal overdoses and crimes.[3] Research has demonstrated that prior arrests are associated with experiencing an opioid overdose, suggesting that offering treatment during these encounters with the CLS may prevent deaths.[79] Given the many contacts among those with an OUD, the care continuum provides opportunities for screening for OUD and overdose risk, treatment or diversion, overdose prevention, and naloxone distribution.[80]

Forced abstinence from opioids during incarceration has been associated with severe, unmanaged withdrawal, aversion to initiating opioid agonist therapy in the community for fear of becoming incarcerated and losing access to these medications, and aversion to using treatment medications generally.[6,13,14,33] Additionally, forced abstinence from opioid use results in a reduced tolerance towards opioids, and if individuals return to pre-incarceration opioid use they may be more likely to experience a fatal overdose. As a result, retention in treatment results in substantial reductions in the risk of death among those with an OUD.[38] However, few individuals are referred to or offered medications for OUD treatment through the CLS,[31,32] raising concerns about equitable access to treatment among this high-risk population.

Evidence suggests that increased access to medications for OUD treatment may improve CLS outcomes and enhance public safety by reducing the demand for and use of illegal drugs. Two systematic reviews of prospective studies conducted in jail and prison-settings demonstrated that the provision of methadone during incarceration in US-settings significantly increased community treatment engagement, and reduced illicit opioid use and injection drug use post-release.[9,10] Naltrexone post-incarceration was associated with a lower rate of relapse than usual care (brief counseling and community referral).[11] Methadone and naltrexone maintenance have been shown to reduce criminal involvement in Europe, with mixed or limited evidence on how these treatments impact crime rates in the US.[9,12] Buprenorphine has also been associated with reduced demand for illegal substances and violent crimes in England.[81] However, little is

known about how these individual-level impacts influence population-level rates of these outcomes.

More research is needed to inform the population-level impact of these OUD treatment policies at the local, state, and national levels. The integration of medications for OUD treatment into a statewide correctional system, both during incarceration and post-release, was associated with substantial reductions in statewide post-incarceration deaths in Rhode Island.[82] Additionally, a Vancouver study demonstrated that using medications for OUD treatment during incarceration resulted in reduced daily prescription opioid use and risk of non-fatal overdose.[83] However, gaps still remain in examining certain health outcomes and evaluating the variability of these policies at the county-level within states.

California has enacted several policies and programs over the past 20 years that have influenced access to OUD treatment in county jails. In 2000, California voters passed the Substance Abuse and Crime Prevention Act (Proposition 36), now an unfunded mandate,[84] which allows for adults convicted of non-violent drug possession offenses to choose community-based treatment instead of incarceration.[85] Proposition 36 significantly increased the number of treatment referrals after implementation and resulted in cost savings to the CLS.[86,87] In 2016, Senate Bill 843 was approved, which required that the California Department of Corrections and Rehabilitation (CDCR), who manages California's prisons, develop and implement a three-year program delivering medications for OUD treatment at one or more state institutions. The program offered naltrexone for OUD treatment in two prisons and evaluation results suggested high retention in treatment and continuity of treatment in the community post-release.[88] In November 2014, California lawmakers passed Proposition 47 (Prop 47), which reduced penalties for lower-level drug and property crimes. Under Prop 47, possession of drugs for personal use is classified as a misdemeanor. Prior to its' passing, offenders could be charged with a felony or a misdemeanor depending on the type and quantity of drug. This policy change resulted in a shift of what would have historically been felony offenses to misdemeanors, which also resulted in more drug-related sentences being served in jails rather than prisons. The policy was also associated with declines in pretrial detention and a narrowing of wide disparities in arrest, conviction, and incarceration rates between white and African Americans living in California.[89] More recently, the California Healthcare Foundation (CHCF) and the California Department of Healthcare Services (CDHCS) launched an initiative to expand access to medications for OUD treatment in community CLS settings by offering funding and technical support to 37 of California's 58 counties.[90] Despite these many policy changes, to our knowledge there has not been an assessment of how the integration of these medications into county jails influences county-level opioid-related outcomes, providing an opportunity to evaluate this policy with the ultimate goal of informing future policies in California and nationwide.

We sought to fill this research gap by conducting structured interviews with key stakeholders in counties throughout California to characterize their jail-based treatment policy and use this information in a quasi-experimental study designed to evaluate how these county-level policies impacted population-level arrests, convictions, emergency department visits, hospitalizations, and deaths.

Methods

Exposure classification

Key stakeholders in each county were interviewed about their county's jail-based treatment policy using a structured interview guide. At minimum, each participating county reported

whether or not each medication approved by the FDA was offered in their county jail for maintenance of existing treatment pre-incarceration and/or induction for those starting a new treatment episode. Stakeholders estimated the month and year each medication began being offered and when they believe the program was at scale (i.e., fully implemented). Key stakeholders in all 58 California counties were identified and contacted through the following sources to invite them to participate in the assessment:

1) Lists of primary contacts for counties participating in a statewide grant program that provides technical support and funding for the expansion of MOUD in county jails
2) Lists of key contacts for jail medical providers from one of the largest contracted medical providers within county jails in California; and
3) Statewide listservs of data managers and epidemiologists.

Requests to participate in the study were sent via e-mail either to the stakeholders directly or via statewide listservs. In September 2021, an electronic survey was distributed to obtain additional counties and reduce the amount of time stakeholders had to spend participating in the study. Several stakeholders contacted other key experts in their county to respond to some survey questions.

Using buprenorphine and methadone, opioid agonist medications, to treat an opioid use disorder has been demonstrated as highly effective in reducing mortality and opioid use in many settings, including prisons and jails. Naltrexone, an opioid antagonist, has evidence of potentially increasing mortality and limited to mixed effectiveness in reducing long-term opioid use. Therefore, our primary exposure focused on the provision of opioid agonist medications for maintenance of existing treatment and induction for those initiating treatment during incarceration. Each county had an indicator that could change from month-to-month denoting whether they had no opioid agonist treatment (OAT) in place, OAT maintenance only, or OAT maintenance and induction. Because of the programmatic implications of implementing these policies, most jails begin by offering OAT maintenance, then later add induction. We did not observe any counties in our sample that returned to only offering OAT maintenance after beginning to offer OAT maintenance and induction. Each county's exposure was categorized based on the number of months it has been in place (0-5 months, 6-11 months, and 12+ months) to offer insight on short and long-term impacts of these policies.

Outcome Classification

We decided *a priori* on public health and criminal legal system outcomes that we believe may be influenced by jail-based medication for opioid use disorder programs and are important indicators for policymakers. All primary outcome data are available from 2005 to 2020, the full study period, and were requested from California state agencies, including the California Departments of Public Health, Justice, and Healthcare Access and Information. All outcome data only covered adult populations (18 years and older). Further information about the formal definition of each indicator, including which codes are included in each, are available in **Appendix A**. Annual population data for adults in each county (18 years and older) from 2005-2020 were obtained from California Department of Finance population estimates and projections.

The following indicators were examined:

1) Public Health
    - Drug overdose deaths (All, Unintentional, Intentional)

- Emergency department visits due to:
    - Primary cause – opioid overdose
    - Any cause – opioid overdose
    - Primary cause – opioid-related
    - Any cause – opioid-related
- Hospitalizations due to:
    - Primary cause – opioid overdose
    - Any cause – opioid overdose
    - Primary cause – opioid-related
    - Any cause – opioid-related

2) Criminal Legal System
    - All arrests
    - Drug-related arrests
    - Drug-related misdemeanor arrests
    - Drug-related felony arrests
    - Non-Drug arrests
    - Property arrests
    - Violent arrests
    - All convictions
    - Drug-related convictions
    - Drug-related misdemeanor convictions
    - Drug-related felony convictions
    - Non-Drug convictions
    - Property convictions
    - Violent convictions

Datasets were created by aggregating raw data files by county, year, and month to generate rates of each outcome from 2005 to 2020. County of residence was used to assign emergency department visits, hospitalizations, and deaths to each county.

Descriptive Analysis

County-months contributed to each exposure category were calculated overtime and graphed via an alluvial plot to examine change through exposure categories during the study period. Crude rates of each outcome were observed overtime by county and in aggregate. Each county's rate overtime was compared to the average of all counties together. Crude rates in the outcome were aggregated for each exposure category. These rates were generated by summing outcomes for each county within that exposure category as the numerator and dividing it by the total population covered by that exposure category for each time-point. All rates are reported per 100,000 residents of each county.

Statistical Analysis

We used negative binomial generalized linear mixed models to quantify the impact each county's policy had on each outcome. During the model building phase, each model iteratively added random effects in the following order to evaluate their impact on model parameters and fit: 1) Random intercepts, 2) Random intercepts + random slopes for pre-exposure time splines; 3) Random intercepts + random slopes for pre-exposure time splines + random slopes for OATMaintain or OATMaintainInduce exposure categories. The addition of random intercepts

captured most of the variability in each outcome between county, with random slopes capturing very little additional variability. However, to remain conservative in our estimates, coefficient estimates reflect the most complex model that converged (i.e., the model that included the most random effects). In cases where the model did not converge with inclusion of all *a priori* random effect parameters, random effects were removed in the order they were added. A comparison between models as an illustration of the model building process is in **Appendix C** using the outcome of deaths as an example. All analyses were performed in R using the glmmADMB package.[91,92]

Each outcome had its own model and each type of policy (OAT maintenance only, OAT maintenance and induction) was modeled separately to examine the overall impact of each without adjustment for the other. The base model formulae for evaluating each policy type are presented below (**Equations 1 and 2**). Each model centered time mid-way through study follow-up at January 2013 and included sine and cosine terms to capture 3-month seasonality,[93] time splines that were relevant to each outcome, an indicator variable for each year from 2006-2020, and an indicator variable for key policy events resulting in changes in outcome definitions (e.g., Prop47). In October 2015, United States medical institutions transitioned from the previously used International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) to ICD-10-CM. Prior studies have demonstrated that surveillance of opioid-related emergency department visits and hospitalizations are meaningfully influenced by this definition change.[94–97] Therefore, all hospitalization and emergency department models included an indicator variable for when this transition occurred that was 0 before October 2015 and 1 afterwards. The Prop 47 indicator was defined similarly and included in all arrest and conviction models. Spline knots were generated based on significant events, including changes in outcome definition, cannabis legalization, the rise of fentanyl contamination of the illegal drug supply, and the Coronavirus 2019 pandemic, as well as descriptive trends in outcomes statewide that signified a meaningful trajectory change. For conviction and arrest models, spline knots were created at November 2011, November 2014, December 2016, and November 2019. For emergency department and hospitalizations models, spline knots were created at January 2011, November 2014, January 2018, and November 2019. For death models, spline knots were created at January 2017 and January 2020.

For **Equations 1 and 2** below, the time unit is month by calendar year, with 192 months of follow-up per county, centered at January 2013. Additionally, t corresponds to the monthly time step, k corresponds to year of follow-up (2006-2020), and j corresponds to county.

Equation 1. Generalized linear mixed model evaluating how the availability of OAT maintenance influences population-level outcomes

$$\log\big(E(y_{jt})\big) = (\beta_0 + b_{j,1}) + (\beta_1 + b_{j,2})TIME1_{jt} + (\beta_2 + b_{j,3})TIME2_{jt} + (\beta_3 + b_{j,4})TIME3_{jt} + (\beta_4 + b_{j,5})OATMaintain0to5Mos_{jt} + (\beta_5 + b_{j,6})OATMaintain6to11Mos_{jt} + (\beta_6 + b_{j,7})OATMaintain12PlusMos_{jt} + (\beta_7 + b_{j,8})OATMaintainInduce_{jt} + \beta_9 Sin\left(2\pi * \frac{TIME_{jt}}{3}\right) + \beta_{10} Cos\left(2\pi * \frac{TIME_{jt}}{3}\right) + \beta_{11} Prop47|ICD910_{jt} + \beta_{12-25} YEAR_k + \log\left(AdultPopulation_{jt}\right)$$

Equation 2. Generalized linear mixed model evaluating how the availability of OAT maintenance and induction influences population-level outcomes

$$\log(E(y_{jt})) = (\beta_0 + b_{j,1}) + (\beta_1 + b_{j,2})TIME1_{jt} + (\beta_2 + b_{j,3})TIME2_{jt} + (\beta_3 + b_{j,4})TIME3_{jt} + (\beta_4 + b_{j,5})OATMaintainInduce0to5Mos_{jt} + (\beta_5 + b_{j,6})OATMaintainInduce6to11Mos_{jt} + (\beta_6 + b_{j,7})OATMaintainInduce12PlusMos_{jt} + (\beta_7 + b_{j,8})OATMaintainenanceOnly_{jt} + \beta_9 Sin(2\pi * \frac{TIME_{jt}}{3}) + \beta_{10} Cos(2\pi * \frac{TIME_{jt}}{3}) + \beta_{11} Prop47|ICD910_{jt} + \beta_{12-25} YEAR_k + \log(AdultPopulation_{jt})$$

Sensitivity Analyses

Given the significant rise in cocaine and stimulant-involved drug overdose deaths in recent years[98], rates of all drug overdose deaths may follow a different trajectory than those for opioid overdose deaths. As jail-based OAT influences opioid-related outcomes explicitly, we expect these policies to influence opioid-specific deaths more than those due to other drugs. We used multiple cause of death (MCOD) data from the California Department of Public Health to identify opioid-specific overdose deaths and those due to methadone and heroin. These data were used to examine the impact these policies have on opioid-specific mortality outcomes. The most recent year of MCOD data available for research use as of March 2022 was 2018. Therefore, all MCOD analyses cover a study period of 2005-2018, ending shortly after fentanyl overdose deaths began exceeding heroin overdose deaths in California. As a result, these sensitivity analyses also provide insight on the impact of these policies in absence of large increases in overdose outcomes due to changes in the drug supply.

County jails may house individuals from another county, resulting in a jail-based OAT policy in one county potentially influencing some outcomes that are assigned to other counties based on the individual's county of residence. Additional sensitivity analyses explored the impact of aggregating data by county of death or visit instead of county of residence for deaths, emergency department visits, and hospitalizations.

Results

Sample Description

Between 2020 and 2021, 26 counties responded to interview requests. Twenty-nine key stakeholders were interviewed to characterize each county's jail-based treatment policy, with most counties including only one stakeholder in the interview process. Three counties had two stakeholders participate in interviews. Twenty-seven stakeholders completed full interviews (93%) and two stakeholders only responded to the electronic survey. Most interviewees worked in the fields of behavioral health/SUD treatment services (n=10, 34%), correctional health (n=8, 28%) or the criminal legal system (n=8, 28%). The most common roles stakeholders held were healthcare provider (n=9, 31%) and SUD treatment staff (n=9, 31%) (**Table 1**).

Table 1. *Description of Key Stakeholders Interviewed to Characterize Jail-based Medication for Opioid Use Disorder Treatment Policies*

Attribute	**Number of Stakeholders Interviewed N=29**	
	n	**(%)**
Field		
Behavioral Health/Substance Use Disorder (SUD) Services	10	(34)
Correctional Health	8	(28)
Criminal Legal System	8	(28)
Public Health	3	(10)
Response Format		
Full interview	27	(93)
Electronic Survey	2	(7)
Role		
Criminal Legal System (CLS) Service Provider	2	(7)
Healthcare Provider	9	(31)
Jail Staff	5	(17)
Public Health Staff	3	(10)
Sheriff's Staff	1	(3)
SUD Treatment Staff	9	(31)

We reached and characterized jail-based treatment policies for 26 counties in California (**Figure 1**). Counties from nearly all California mental health regions (Superior Counties, Central Counties, Bay Area Counties, Southern Counties) were captured in this study, with the exception of the Los Angeles Region, which only includes Los Angeles County. Study counties made up 48% of California's adult population in 2020 (14,677,195 adults in study counties over 30,778,230 adults in all of California).

We did not identify any statistically significant differences in key demographic factors between counties who did (n=26) and did not (n=31) participate in the study (**Table 2**). Although ED visit and hospitalization rates overall were similar between counties who did and did not participate in this study, participating counties had a significantly higher rate of opioid-related ED visits (5.73 vs. 4.18 ED visits per 100,000 residents) and visits due to overdoses (3.93 vs. 2.74 ED visits per 100,000 residents). This relationship is also present for drug overdose deaths (29.31 vs. 25.46 drug overdose deaths per 100,000 residents), though is not statistically significant. Although not statistically significant, counties who did not participate in the study had a smaller median population, larger median percentage of people living in a rural area, and a higher median average daily jail population. Non-participating counties also had a higher median arrest rate, drug arrest rate, conviction rate, and drug conviction rate in 2020 as compared to participating counties, though, as noted above, this difference was not statistically significant.

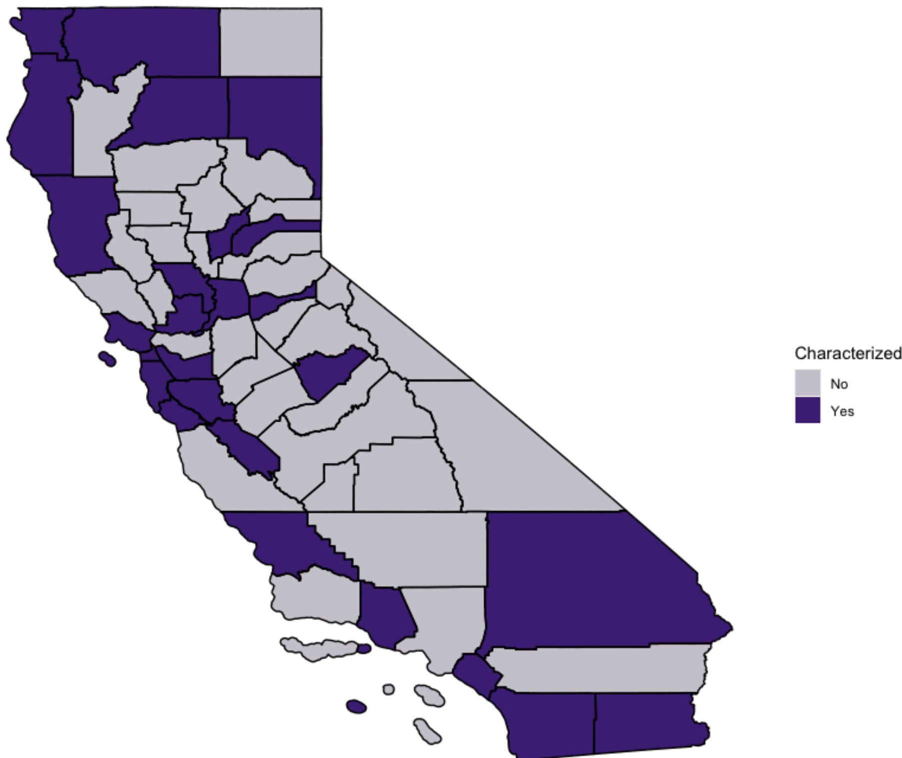
Table 2. *Comparison of Attributes between California Counties who did (N=26) and did not (N=31)* participate in an interview about their jail-based medication for opioid use disorder policies*

Attribute	Counties that participated N=26 Median [IQR]		Counties that did not participate N=31 Median [IQR]		p-value+
DEMOGRAPHICS					
Population	190,968	[60,488, 736,766]	114,750	[20,686, 362,494]	0.16
Percentage of the Population Living in Rural Areas	14.32	[3.17, 32.69]	17.19	[10.66, 47.06]	0.09
Daily Jail Population	379	[213, 1,465]	446	[99, 1,013]	0.44
Household income	71,421	[54,362, 90,027]	60,321	[56,889,72,767]	0.13
Residential Segregation	26.50	[22.25, 35.00]	24.00	[20.25, 29.75]	0.22
HEALTH OUTCOMES (2020)					
Emergency Department (ED) Visit Rate	32,430.28	[22,382.60, 37,729.34]	29,055.54	[26,299.21, 34,843.91]	0.86
Primary diagnosis-Overdose ED Visit Rate	3.93	[3.12, 4.73]	2.74	[2.23, 3.97]	**0.03**
Primary diagnosis-Opioid-related ED Visit Rate	5.73	[4.35, 7.74]	4.18	[3.22, 6.17]	**0.04**
Hospitalization Rate	8,512.67	[7,292.90, 9,251.13]	9,665.72	[8,352.80, 10,228.15]	0.10
Primary diagnosis-Overdose Hospitalization Rate	0.91	[0.78, 1.28]	1.13	[0.74, 1.61]	0.51
Primary diagnosis-Opioid-Related Hospitalization Rate	1.17	[0.85, 1.63]	1.27	[0.81, 1.79]	0.68
Death Rate	1,116.64	[899.57, 1,362.13]	1,152.20	[1,024.93, 1,323.36]	0.61
Drug Overdose Death Rate	29.31	[23.95, 36.75]	25.46	[20.06, 35.66]	0.15
CRIMINAL LEGAL SYSTEM OUTCOMES (2020)					
Arrest Rate	2874.40	[2062.27, 3971.49]	2848.51	[2,418.28, 4,164.81]	0.48
Drug Arrest Rate	715.89	[530.80, 995.51]	783.95	[490.51, 1,024.29]	0.97
Conviction Rate	837.15	[518.10, 1,239.39]	899.11	[503.77, 1,253.43]	0.89
Drug Conviction Rate	77.08	[46.59, 137.59]	90.21	[42.94, 159.75]	0.81

+P-values based on the non-parametric Kruskal-Wallis Rank Sum Test

*Alpine County was dropped from all analyses as their data were suppressed for most outcomes due to confidentiality requirements for small populations.

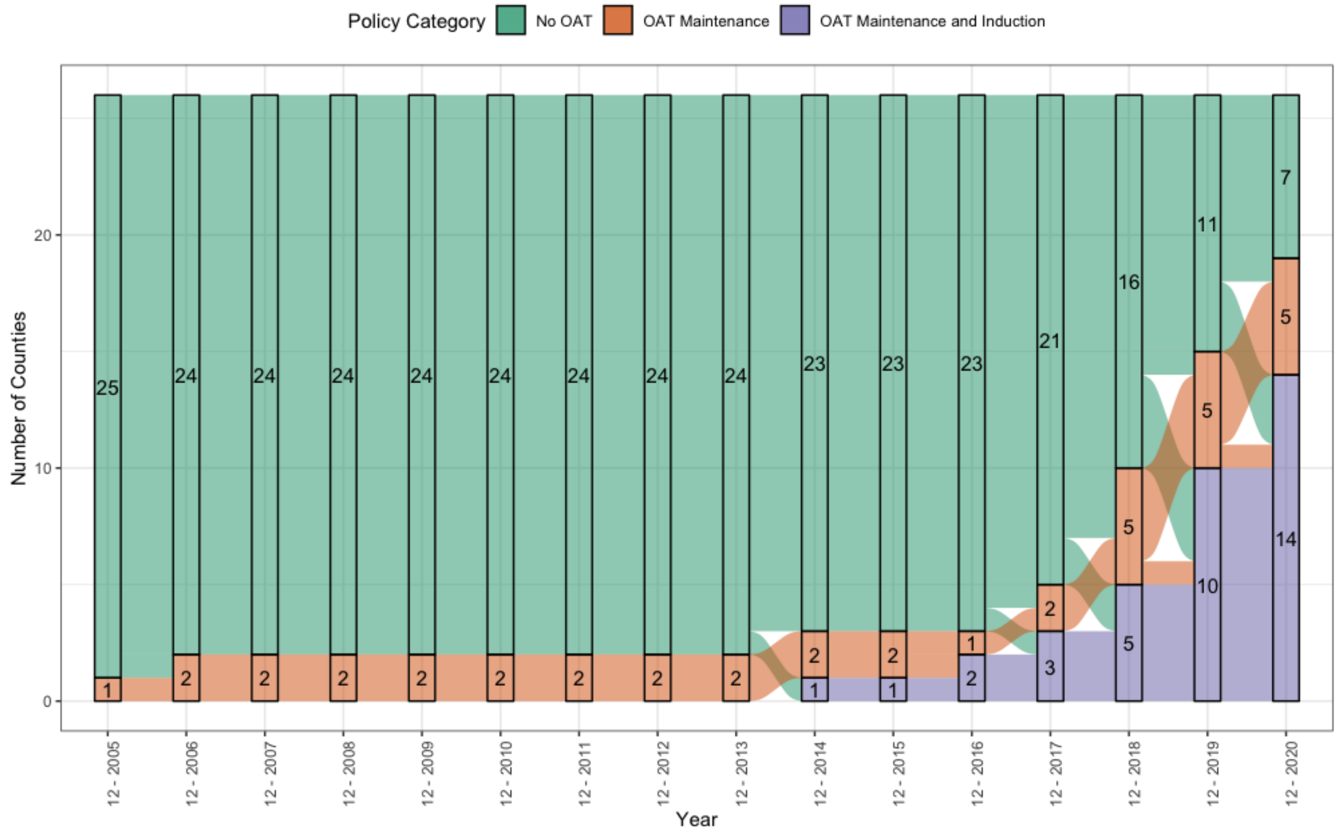
Figure 1. *Geographic Distribution of California Counties Interviewed (N=26)*



Exposure Description

Figure 2 displays the number of counties contained in each policy category at the end of each year of study follow-up. At the beginning of follow-up, only 1 county offered OAT maintenance only. By the end of follow-up on December 2020, 19 out of 26 counties interviewed offered some form of opioid agonist treatment in their jail(s). The most common form of OAT offered for induction (n=14 counties) and maintenance (n=19 counties) was buprenorphine. 10 counties also offered methadone for maintenance therapy, with only 1 offering it for inductions during the study period.

Figure 2. *Movement between jail-based opioid agonist treatment (OAT) policy categories by the end of each year for 26 California counties – 2005-2020*

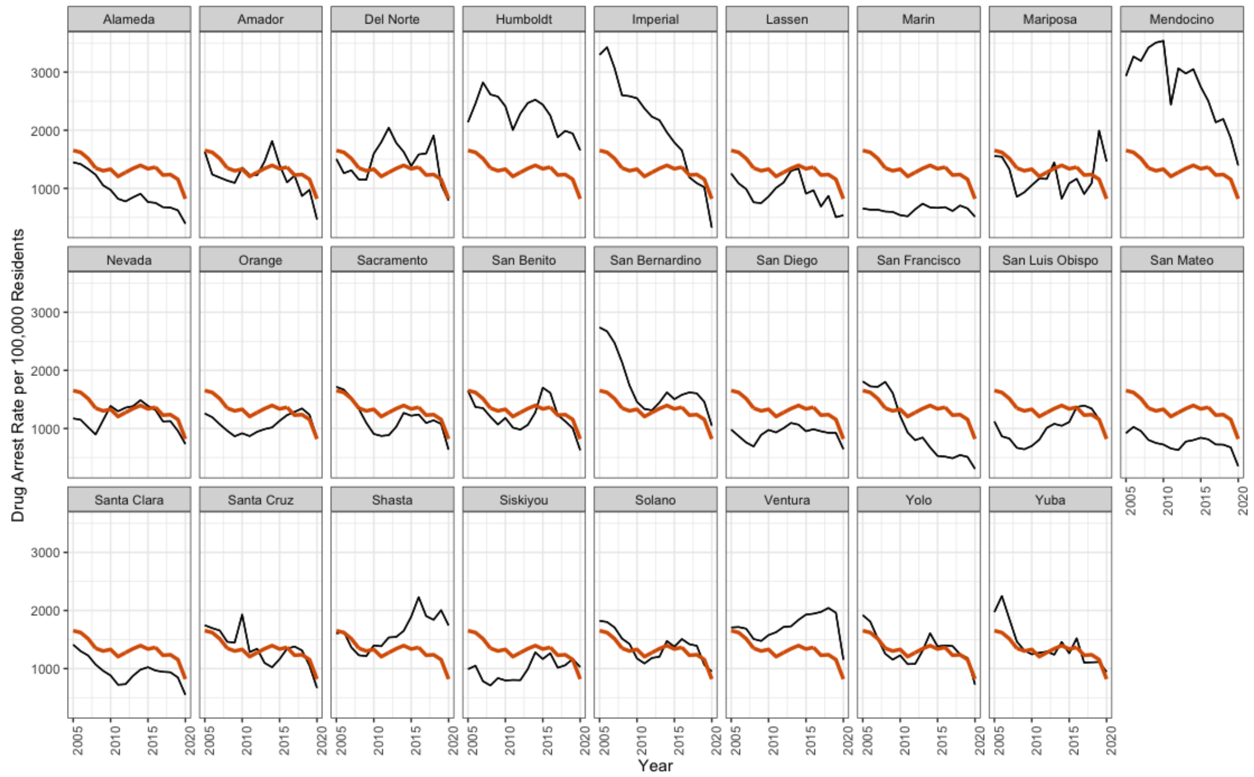


OAT=Opioid agonist treatment

Outcome: Arrest Rates

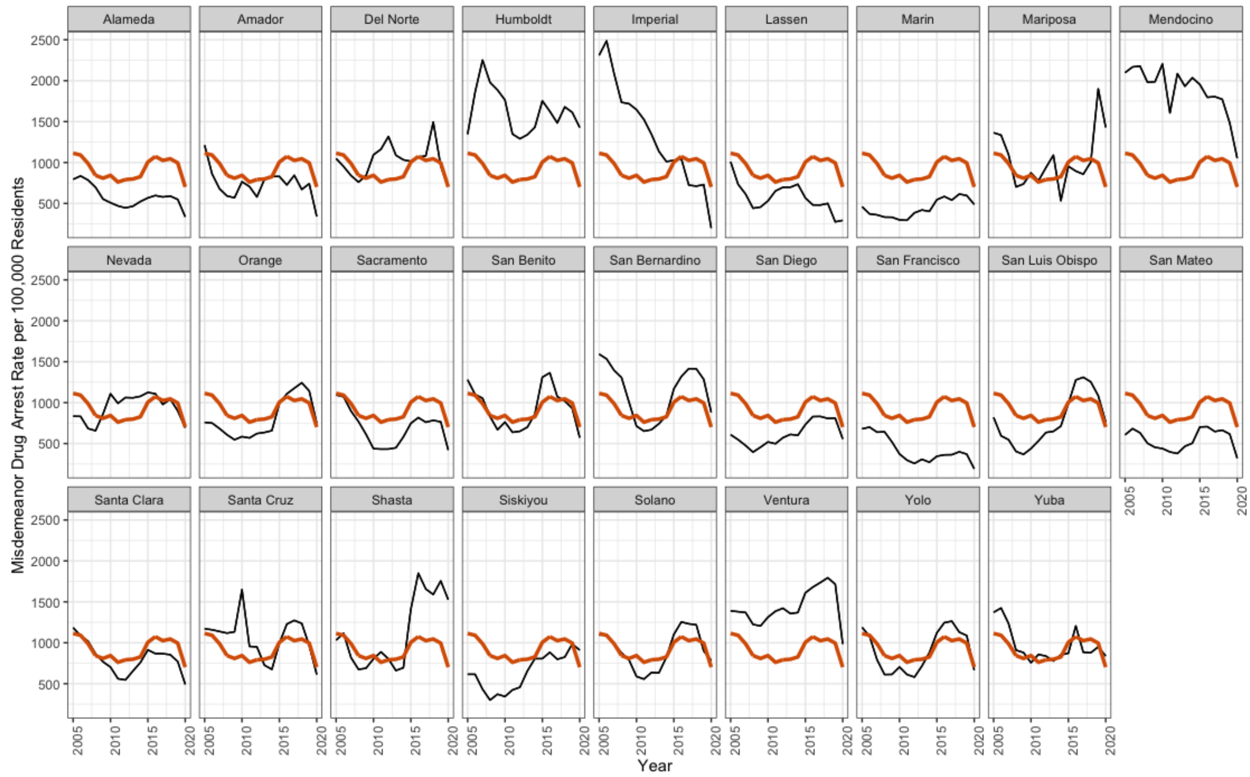
Crude arrest rates by county showed variability in their magnitude, which is likely related to population size (**Figures 3-5**). The rate of all, misdemeanor, and felony drug-related arrests has generally decreased since 2005, with decreases in felony drug-related arrests in 2014-2015 corresponding with expected increases in misdemeanor drug-related arrests due to Prop 47 re-classifying many offenses that were previously considered felonies to misdemeanors.

Figure 3. *Drug arrest rates per 100,000 residents for 26 counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*



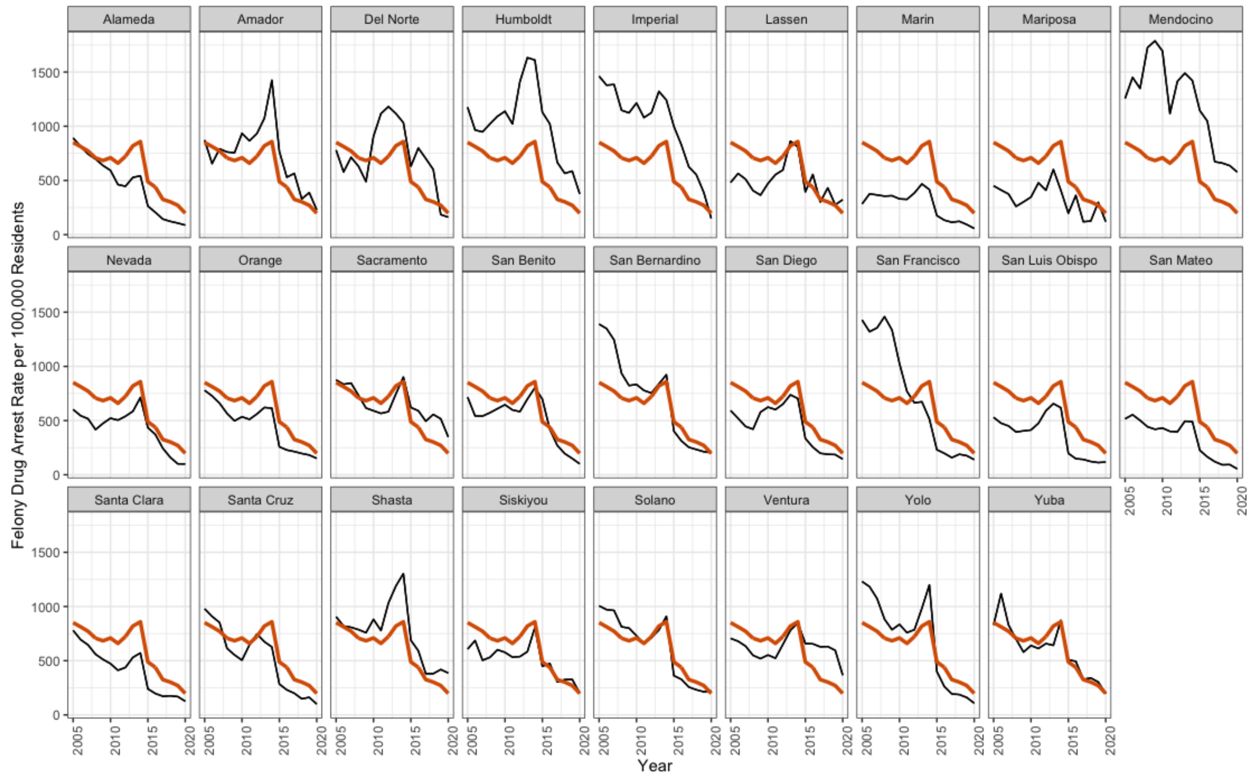
The average rate from all 26 counties combined is shown in orange.

Figure 4. *Misdemeanor drug arrest rates per 100,000 residents for 26 counties included in a study of jail-based opioid agonist treatment programs– 2005-2020*



The average rate from all 26 counties combined is shown in orange.

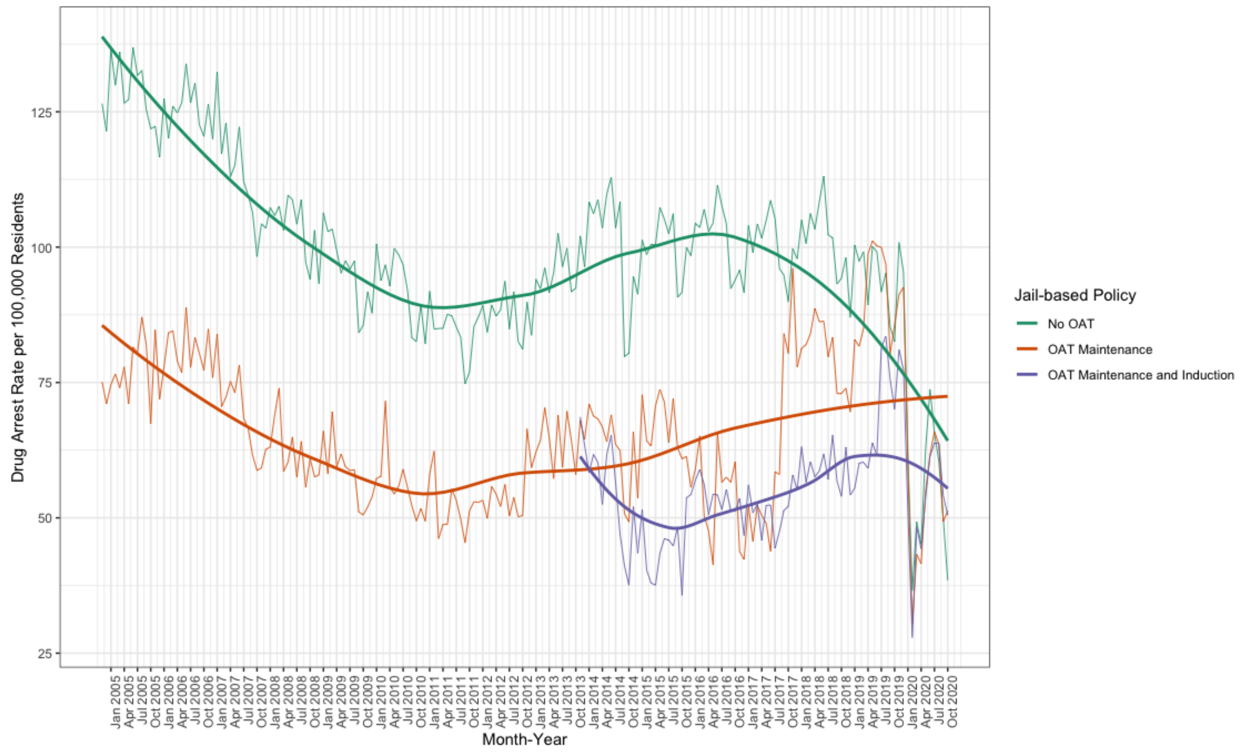
Figure 5. *Felony drug arrest rates per 100,000 residents for 26 counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*



The average rate from all 26 counties combined is shown in orange.

Figure 6 displays the crude drug arrest rate by exposure category from 2005 to 2020. Counties without jail-based opioid agonist treatment had consistently higher drug arrest rates than those who had OAT maintenance only or OAT maintenance and induction. Notably, counties with jail-based OAT programs started with a lower drug arrest rate than those without these programs. In 2020, the crude rate for counties without jail-based OAT programs reduced to similar levels as those seen for counties with OAT policies. Note that a different number of counties contributes to each of these exposure categories overtime, thus variability around some estimates may be larger than others.

Figure 6. *Crude drug arrest rates per 100,000 residents by exposure categories overtime in 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*



Final model coefficients and adjusted incident rate ratios are displayed in **Figure 7** and **Table 3**. We did not identify a relationship between jail-based OAT policies and population-level violent arrest rates. Counties who had jail-based OAT maintenance policies for 12 or more months experienced an increase of approximately 7% in their population-level drug arrest rate (95% CI: 1-14%) and 18% in their population-level felony drug arrest rate (95% CI: 4-34%) as compared to counties without jail-based OAT policies. Similar results were observed for counties with jail-based OAT maintenance and induction policies for 12 months or more (increase of 14%, 95% CI: 0-29%). In contrast, counties with OAT maintenance and induction policies for between 6-11 months saw an approximately 10% reduction in their population-level arrest rate (95% CI: 0-19%) and 10% reduction in their population-level non-drug arrest rate (95% CI: 0-18%), with point estimates suggesting smaller reductions in population-level rates during additional exposure time periods (0-5 months and 12+ months).

Figure 7. *Adjusted coefficient estimates for the association between jail-based opioid agonist treatment policies and drug arrest rates – 2005-2020*

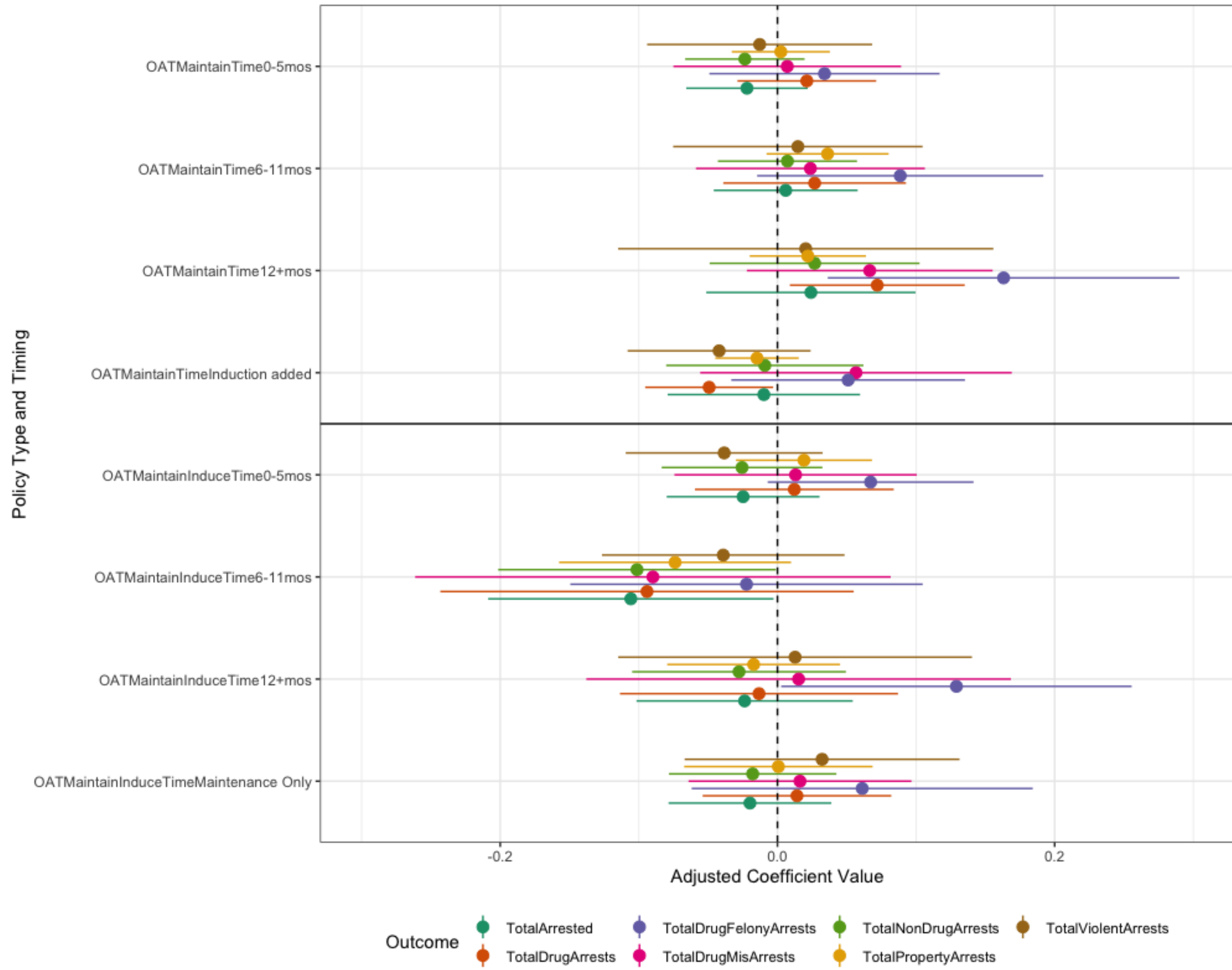


Table 3. *Incidence rate ratios and 95% confidence intervals for the association between Jail-based opioid agonist treatment policies and county-level arrest rates in 26 California counties – 2005-2020*

Jail-based Policy Category	**All Arrests**		**Drug Arrests**		**Drug Felony Arrests**		**Drug Misdemeanor Arrests**		**Non-drug Arrests**		**Property Arrests**		**Violent Arrests**	
	IRR (95% CI)	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	0.98 (0.94 – 1.02)	0.33	1.02 (0.97 – 1.07)	0.41	1.03 (0.95 – 1.12)	0.42	1.01 (0.93 – 1.09)	0.87	0.98 (0.94 – 1.02)	0.29	1.00 (0.97 – 1.04)	0.89	0.99 (0.91 – 1.07)	0.76
OAT Maintenance: 6-11 Months	1.01 (0.96 – 1.06)	0.82	1.03 (0.96 – 1.10)	0.43	1.09 (0.99 – 1.21)	0.09	1.02 (0.94 – 1.11)	0.57	1.01 (0.96 – 1.06)	0.78	1.04 (0.99 – 1.08)	0.11	1.01 (0.93 – 1.11)	0.75
OAT Maintenance: 12+ Months	1.02 (0.95 – 1.10)	0.53	1.07 (1.01 – 1.14)	**0.03**	1.18 (1.04 – 1.34)	**0.01**	1.07 (0.98 – 1.17)	0.14	1.03 (0.95 – 1.11)	0.49	1.02 (0.98 – 1.07)	0.31	1.02 (0.89 – 1.17)	0.77
OAT Maintenance with Induction Added	0.99 (0.92 – 1.06)	0.78	0.95 (0.91 – 1.00)	**0.04**	1.05 (0.97 – 1.14)	0.24	1.06 (0.95 – 1.18)	0.32	0.99 (0.92 – 1.06)	0.80	0.99 (0.96 – 1.02)	0.34	0.96 (0.90 – 1.02)	0.21
OAT Maintenance and Induction: 0-5 Months	0.98 (0.92 – 1.03)	0.38	1.01 (0.94 – 1.09)	0.74	1.07 (0.99 – 1.15)	0.08	1.01 (0.93 – 1.11)	0.77	0.97 (0.92 – 1.03)	0.39	1.02 (0.97 – 1.07)	0.44	0.96 (0.90 – 1.03)	0.29
OAT Maintenance and Induction: 6-11 Months	0.90 (0.81 – 1.00)	**0.04**	0.91 (0.78 – 1.06)	0.22	0.98 (0.86 – 1.11)	0.73	0.91 (0.77 – 1.09)	0.30	0.90 (0.82 – 1.00)	**0.05**	0.93 (0.85 – 1.01)	0.08	0.96 (0.88 – 1.05)	0.38
OAT Maintenance and Induction: 12+ Months	0.98 (0.90 – 1.06)	0.55	0.99 (0.89 – 1.09)	0.79	1.14 (1.00 – 1.29)	**0.05**	1.02 (0.87 – 1.18)	0.84	0.97 (0.90 – 1.05)	0.48	0.98 (0.92 – 1.05)	0.59	1.01 (0.89 – 1.15)	0.8
OAT Maintenance Only	0.98 (0.92 – 1.04)	0.51	1.01 (0.95 – 1.09)	0.68	1.06 (0.94 – 1.20)	0.33	1.02 (0.94 – 1.10)	0.69	0.98 (0.92 – 1.04)	0.56	1.00 (0.93 – 1.07)	0.98	1.03 (0.94 – 1.14)	0.52

Outcome: Conviction Rates

Similar to what was observed for drug-related arrest rates, rates of all, misdemeanor, and felony drug-related convictions have generally decreased since 2005 (**Figure 8**).

Figure 8. *Drug conviction rates per 100,000 residents for 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

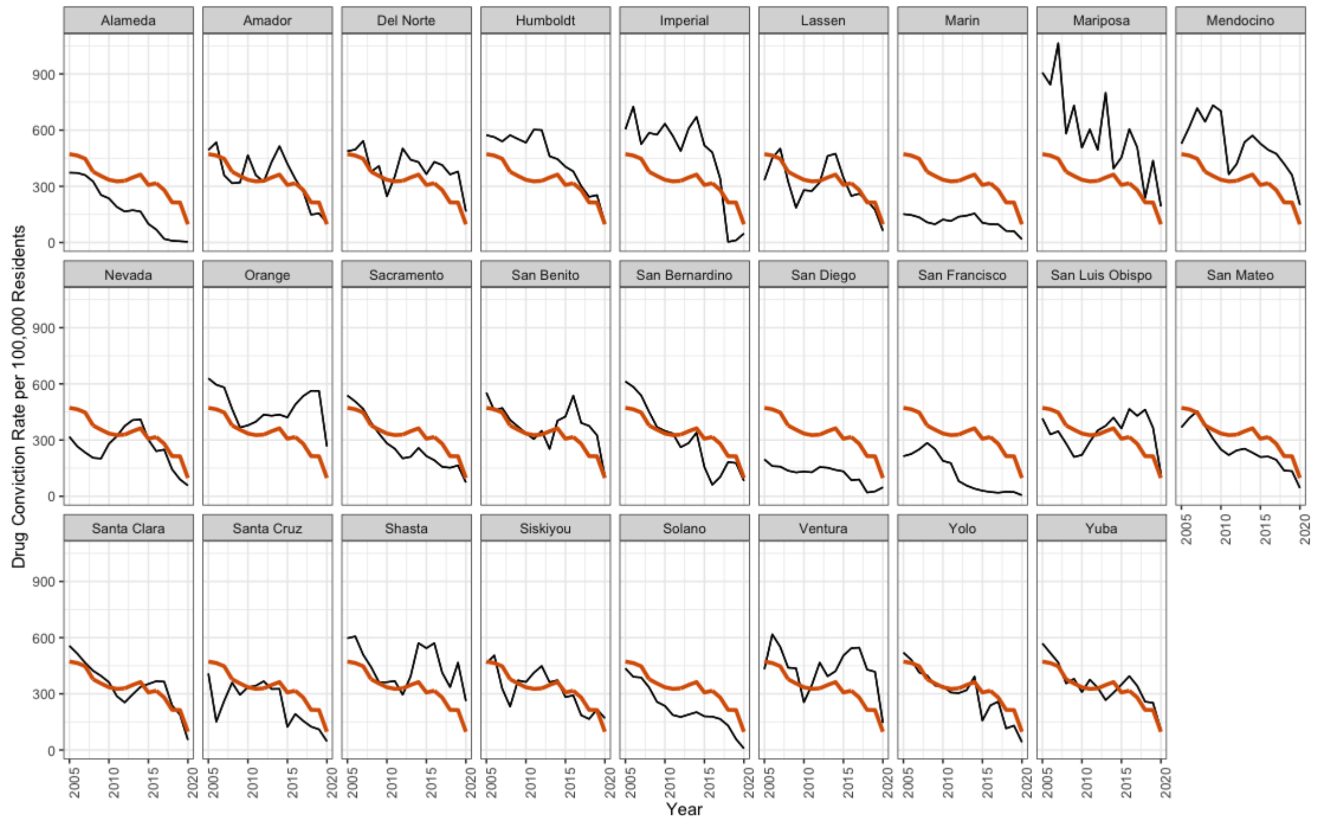


Figure 9 displays the crude drug conviction rate by exposure category from 2005 to 2020. Counties without jail-based opioid agonist treatment had higher drug arrest rates than those who had OAT maintenance only or OAT maintenance and induction until 2019, when they began to sharply decrease. This decrease may potentially be a result of counties with higher conviction rates moving into other exposure categories overtime. Counties with jail-based OAT maintenance and induction programs started with a notably lower drug-related conviction rate than those without these programs. Counties with jail-based OAT maintenance policies were decreasing at similar rates to those without jail-based OAT. However, this decrease flattened out beginning around 2014.

Figure 9. *Crude drug conviction rates per 100,000 residents by exposure categories overtime in 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

Final model coefficients and adjusted incident rate ratios for conviction outcomes are displayed in **Figure 10** and **Table 4**. We did not identify a relationship between jail-based OAT policies and population-level violent convictions. Interestingly, counties with OAT maintenance and induction policies in place for 6 to 11 months saw a statistically significant decrease in drug felony convictions (IRR: 0.70; 95% CI: 0.53-0.94), while those with OAT maintenance and induction policies for 12 months or more saw an increase in drug misdemeanor convictions. This may be a result of a perception that the criminal legal system can be used to deliver treatment for substance use disorders counties with OAT maintenance and induction policies or reflecting the known changes in felony drug-related crimes being re-classified to misdemeanors beginning in 2014. We observed increases in non-drug (IRR 1.13, 95% CI: 1.02-1.24) and property (IRR: 1.28, 95% CI: 1.06-1.54) convictions in counties with jail-based OAT maintenance only policies for 12 months or more as compared to those without jail-based OAT. Property convictions were also elevated for counties with OAT maintenance only policies for 6-11 months (IRR: 1.19, 95% CI: 1.05-1.35).

Figure 10. *Coefficient comparison plot from final generalized linear mixed models for the association between jail-based opioid agonist treatment policies and drug conviction rates – 2005-2020*

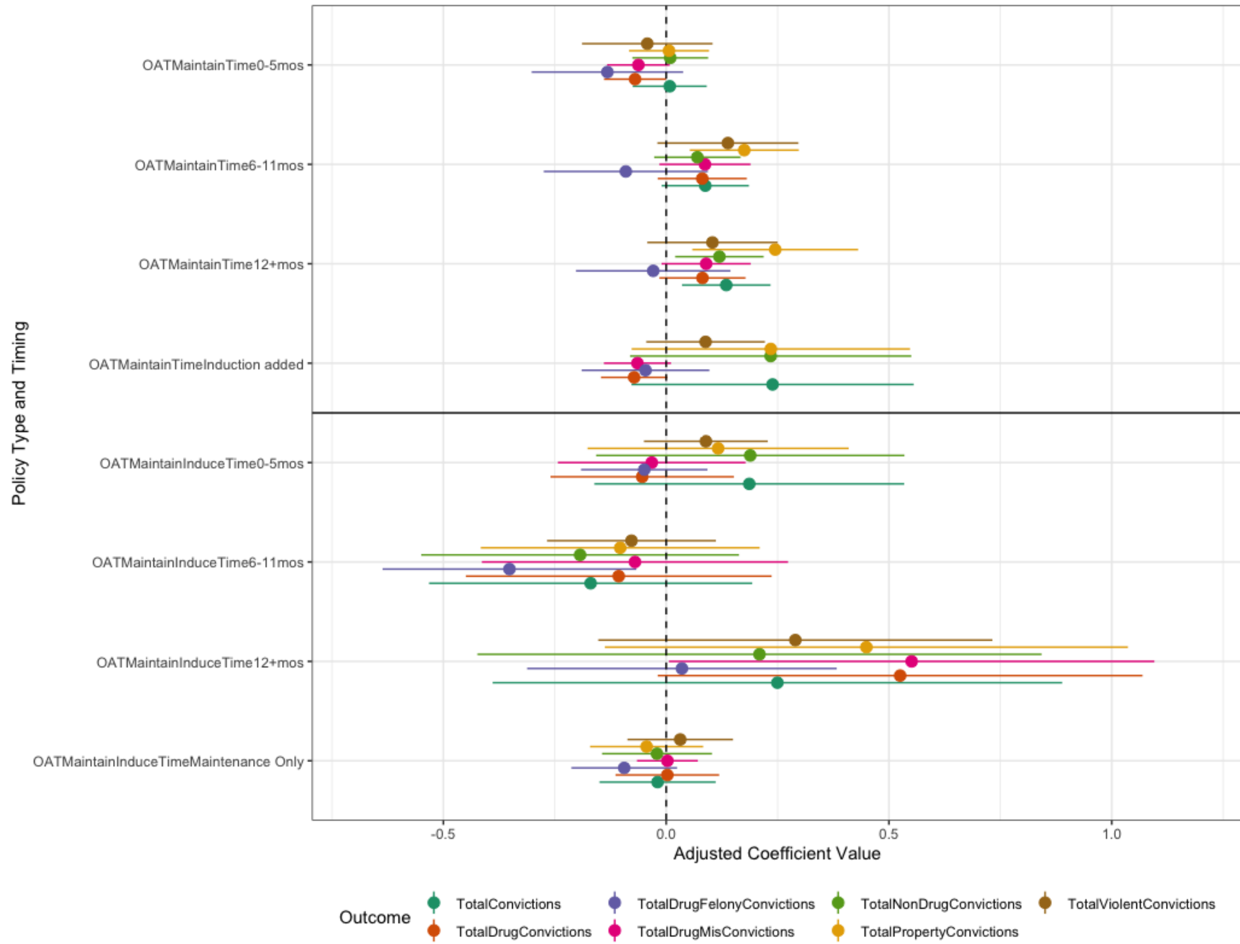


Table 4. *Incidence rate ratios and 95% confidence intervals for the association between jail-based opioid agonist treatment policies and county-level conviction rates in 26 California counties – 2005-2020*

Jail-based Policy Category	All Convictions *IRR (95% CI)*	*p*	Drug Convictions *IRR (95% CI)*	*p*	Drug Felony Convictions *IRR (95% CI)*	*p*	Drug Misdemeanor Convictions *IRR (95% CI)*	*p*	Non-drug Convictions *IRR (95% CI)*	*p*	Property Convictions *IRR (95% CI)*	*p*	Violent Convictions *IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	1.01 (0.93 – 1.10)	0.85	0.93 (0.87 – 1.00)	**0.05**	0.88 (0.74 – 1.04)	0.13	0.94 (0.88 – 1.01)	0.08	1.01 (0.93 – 1.10)	0.83	1.01 (0.92 – 1.10)	0.89	0.96 (0.83 – 1.11)	0.57
OAT Maintenance: 6-11 Months	1.09 (0.99 – 1.20)	0.08	1.08 (0.98 – 1.20)	0.11	0.91 (0.76 – 1.10)	0.34	1.09 (0.98 – 1.21)	0.10	1.07 (0.97 – 1.18)	0.16	1.19 (1.05 – 1.35)	**<0.001**	1.15 (0.98 – 1.35)	0.09
OAT Maintenance: 12+ Months	1.14 (1.04 – 1.26)	**0.01**	1.08 (0.98 – 1.20)	0.10	0.97 (0.82 – 1.16)	0.74	1.09 (0.99 – 1.21)	0.08	1.13 (1.02 – 1.24)	**0.02**	1.28 (1.06 – 1.54)	**0.01**	1.11 (0.96 – 1.28)	0.16
OAT Maintenance with Induction Added	1.27 (0.93 – 1.74)	0.14	0.93 (0.86 – 1.00)	0.06	0.95 (0.83 – 1.10)	0.53	0.94 (0.87 – 1.01)	0.09	1.26 (0.92 – 1.73)	0.15	1.26 (0.93 – 1.73)	0.14	1.09 (0.96 – 1.25)	0.19
OAT Maintenance and Induction: 0-5 Months	1.21 (0.85 – 1.71)	0.29	0.95 (0.77 – 1.16)	0.61	0.95 (0.83 – 1.10)	0.50	0.97 (0.78 – 1.20)	0.76	1.21 (0.85 – 1.71)	0.28	1.12 (0.84 – 1.51)	0.44	1.09 (0.95 – 1.26)	0.21
OAT Maintenance and Induction: 6-11 Months	0.84 (0.59 – 1.21)	0.36	0.90 (0.64 – 1.27)	0.54	0.70 (0.53 – 0.94)	**0.02**	0.93 (0.66 – 1.31)	0.69	0.82 (0.58 – 1.18)	0.29	0.90 (0.66 – 1.23)	0.52	0.93 (0.77 – 1.12)	0.42
OAT Maintenance and Induction: 12+ Months	1.28 (0.68 – 2.43)	0.44	1.69 (0.98 – 2.91)	0.06	1.04 (0.73 – 1.47)	0.84	1.73 (1.01 – 2.99)	**0.05**	1.23 (0.65 – 2.32)	0.52	1.57 (0.87 – 2.82)	0.13	1.34 (0.86 – 2.08)	0.20
OAT Maintenance Only	0.98 (0.86 – 1.12)	0.77	1.00 (0.89 – 1.13)	0.96	0.91 (0.81 – 1.02)	0.12	1.00 (0.94 – 1.07)	0.94	0.98 (0.87 – 1.11)	0.74	0.96 (0.84 – 1.09)	0.50	1.03 (0.92 – 1.16)	0.60

Outcome: Drug Overdose Deaths

Crude drug overdose rates by county showed variability in their magnitude, likely related to population size (**Figure 11**). The rate of all drug overdoses has been gradually increasing since 2005, with a marked increase beginning in 2017-2018. This increase is more pronounced in urban counties like San Francisco, San Mateo, and San Diego. This time period corresponds to when fentanyl deaths began to replace heroin deaths in California.[99] Accidental drug overdoses followed a similar trajectory to all drug overdoses, as might be expected given they comprise a large proportion of all drug overdoses. Intentional drug overdoses were a relatively rare event comparatively, and largely showed a decreasing trend during the study period.

Figure 11. *Drug overdose death rates per 100,000 residents for 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

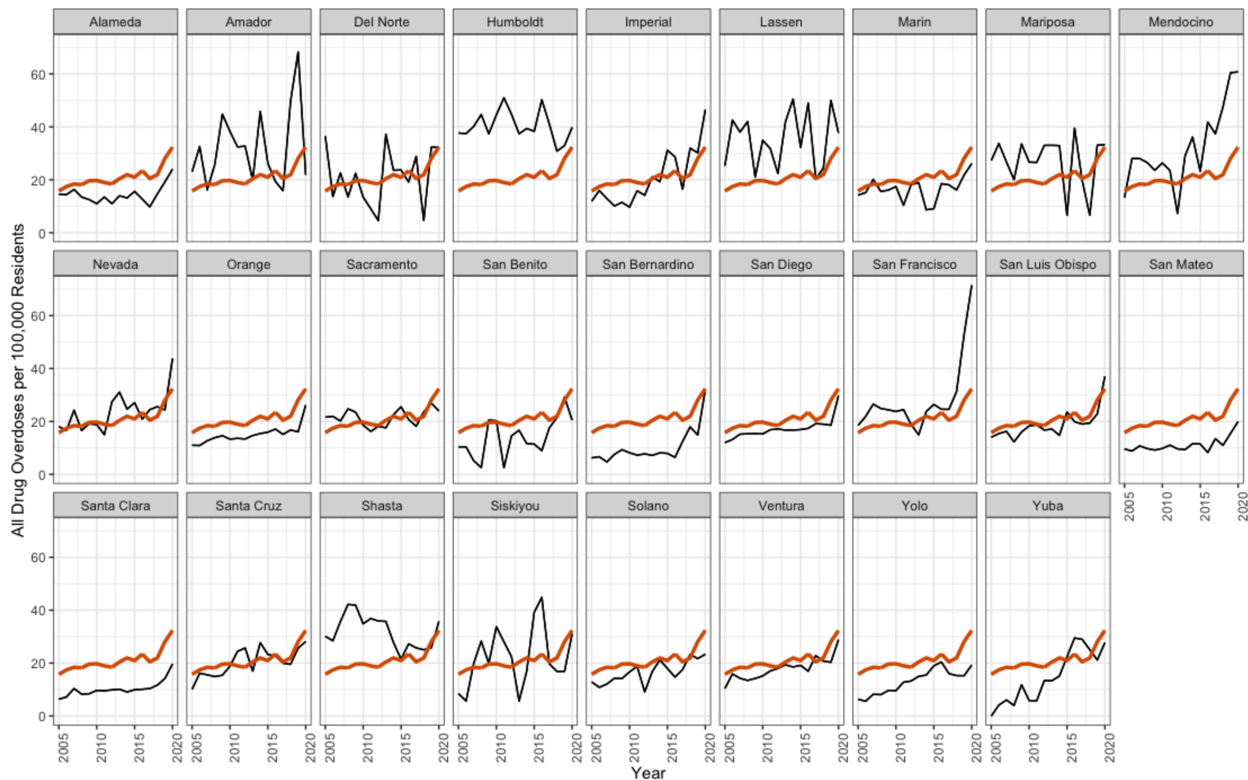
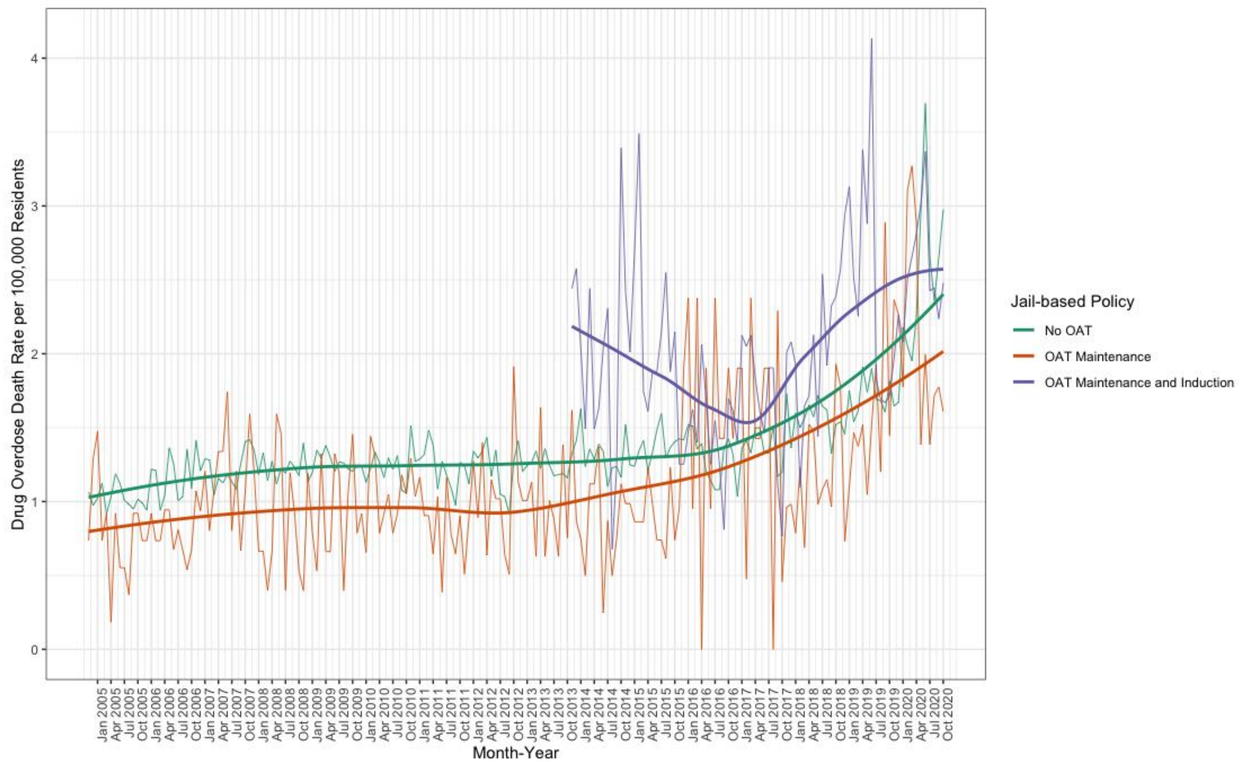


Figure 12 displays the crude drug overdose death rate per 100,000 residents by exposure category from 2005 to 2020. Counties with jail-based OAT maintenance and induction policies started with higher population-level drug overdose death rates than counties with OAT maintenance only policies or those with no OAT. This contrasts with the relationship observed for arrest outcomes where counties with OAT Maintenance and Induction policies had a consistently lower rate than counties with no OAT. Some of this notable increase may be driven by large urban counties like San Francisco contributing a lot of OAT maintenance and induction exposure-time and concurrently experiencing high drug overdose death rates due to fentanyl contamination and shifts in drug use habits.

Figure 12. *Crude drug overdose death rates per 100,000 residents by exposure categories overtime in 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*



Final model coefficients and adjusted incident rate ratios for the ecologic relationship between jail-based OAT policies and population-level drug overdose deaths are displayed in **Figure 13** and **Table 5**. We did not identify a statistically significant relationship between jail-based OAT policies and population-level drug overdose, accidental drug overdose, or intentional drug overdose deaths.

Figure 13. *Coefficient comparison plot from final generalized linear mixed models for the association between jail-based opioid agonist treatment policies and drug overdose rates – 2005-2020*

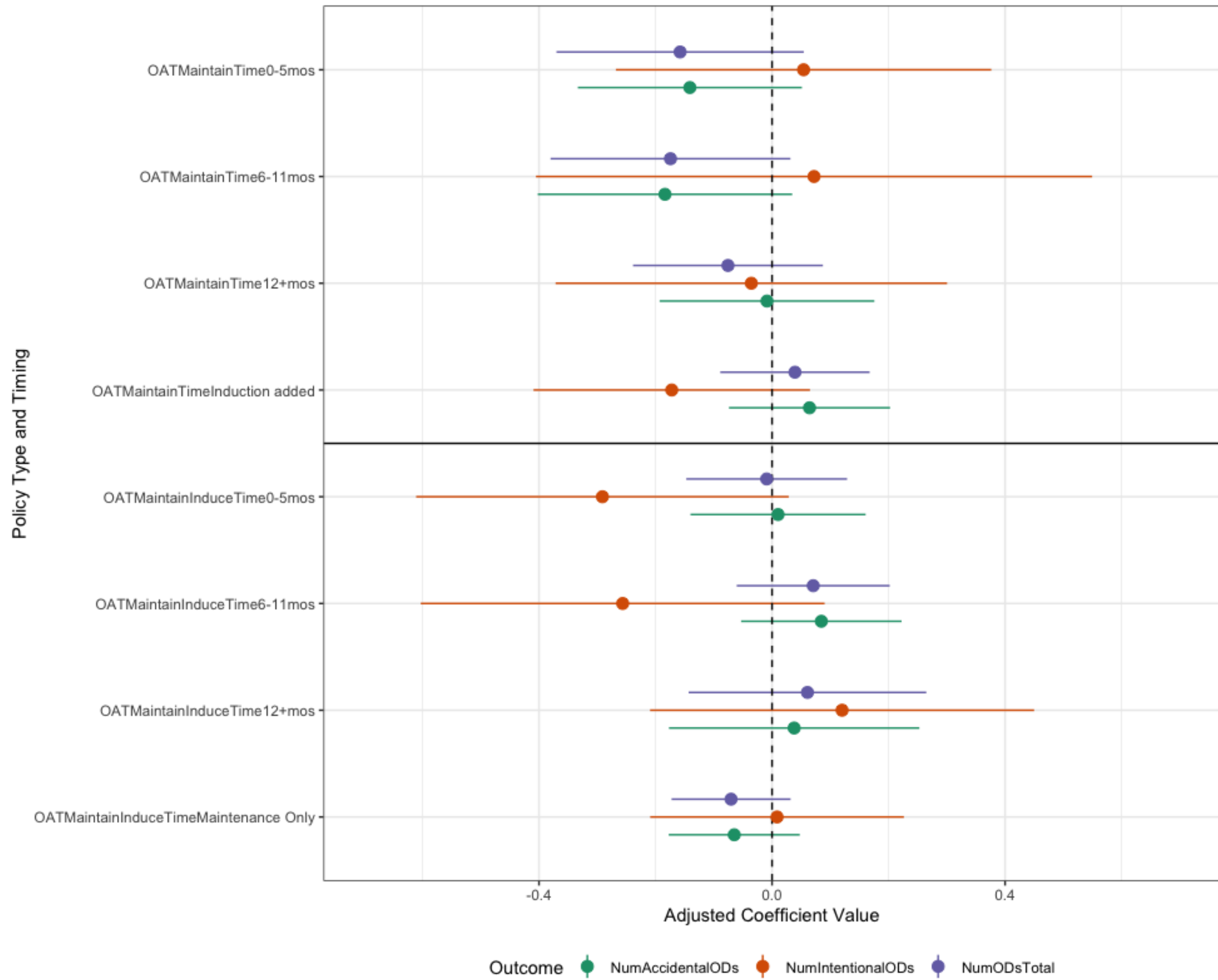


Table 5. *Incidence rate ratios and 95% confidence intervals for the association between jail-based opioid agonist treatment policies and county-level drug overdose rates by county of residence in 26 California counties – 2005-2020*

Jail-based Policy Category	All Drug Overdoses IRR (95% CI)	All Drug Overdoses *p*	Accidental Drug Overdoses IRR (95% CI)	Accidental Drug Overdoses *p*	Intentional Drug Overdoses IRR (95% CI)	Intentional Drug Overdoses *p*
OAT Maintenance: 0-5 Months	0.85 (0.69 – 1.06)	0.15	0.87 (0.72 – 1.05)	0.15	1.06 (0.76 – 1.46)	0.74
OAT Maintenance: 6-11 Months	0.84 (0.68 – 1.03)	0.10	0.83 (0.67 – 1.04)	0.10	1.07 (0.67 – 1.73)	0.77
OAT Maintenance: 12+ Months	0.93 (0.79 – 1.09)	0.36	0.99 (0.82 – 1.19)	0.93	0.97 (0.69 – 1.35)	0.84
OAT Maintenance with Induction Added	1.04 (0.92 – 1.18)	0.55	1.07 (0.93 – 1.22)	0.36	0.84 (0.66 – 1.07)	0.15
OAT Maintenance and Induction: 0-5 Months	0.99 (0.86 – 1.14)	0.90	1.01 (0.87 – 1.17)	0.89	0.75 (0.54 – 1.03)	0.07
OAT Maintenance and Induction: 6-11 Months	1.07 (0.94 – 1.22)	0.29	1.09 (0.95 – 1.25)	0.23	0.77 (0.55 – 1.09)	0.15
OAT Maintenance and Induction: 12+ Months	1.06 (0.87 – 1.30)	0.56	1.04 (0.84 – 1.29)	0.73	1.13 (0.81 – 1.57)	0.47
OAT Maintenance Only	0.93 (0.84 – 1.03)	0.18	0.94 (0.84 – 1.05)	0.26	1.01 (0.81 – 1.25)	0.94

Sensitivity Analysis: Opioid-Specific Drug Overdose Deaths

The relationships observed between jail-based OAT policies and population-level opioid-specific overdose deaths were different from those observed for all drug overdose deaths during the same time period (**Figure 14, Table 6**). Although a statistically significant increase was observed in all drug overdose rates in counties with OAT maintenance and induction policies for more than 12 months (IRR: 1.45, 95% CI: 1.19-1.77), no significant increases were noted in opioid-related deaths (IRR: 1.17, 95% CI: 0.86-1.60). A similar relationship was observed for accidental drug overdoses. These findings suggest that other types of drugs not expected to be influenced by jail-based OAT policies may be influencing relationships between this exposure and population-level drug overdose rates. This analysis also revealed new relationships. Counties with OAT maintenance policies for 0-5 months saw an estimated 31% lower opioid-related death rate than those without jail-based OAT policies (95% CI: 0-53%). A similar reduction was observed for counties with OAT maintenance policies for 12 months or more, where the population-level rate of intentional opioid overdoses was 46% lower (95% CI: 5-69%) than counties without jail-based OAT.

When examining deaths involving heroin and methadone, we did not observe a statistically significant relationship between jail-based OAT Maintenance and Induction policies and methadone- or heroin-involved deaths (**Figure 15, Table 7**). Counties with jail-based OAT maintenance policies for between 6 and 11 months saw decreases of 57% in heroin-involved (95% CI: 1-81%) and 60% in heroin overdose death rates (95% CI: 5-83%) as compared to those without jail-based OAT. This decrease was not sustained for counties that had this policy for fewer or more months. Lastly, counties with OAT maintenance policies for 12 or more months had a significant reduction of 42% in methadone-involved death rates (95% CI: 5-65%) (**Figure 15, Table 7**).

Figure 14. *Coefficient comparison plot between opioid-specific and drug overdose deaths for a study of jail-based opioid agonist treatment policies in 26 California counties – 2005-2018*

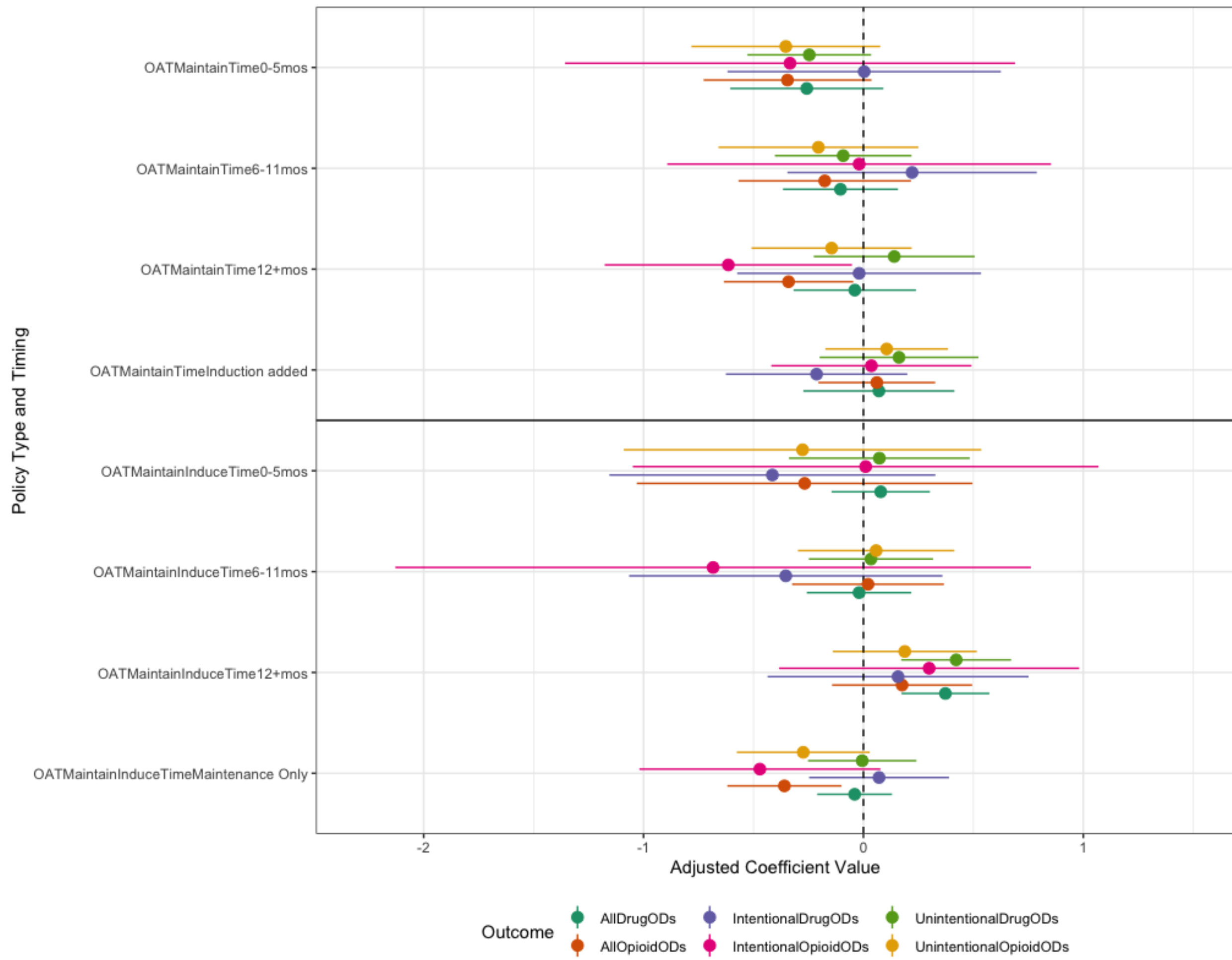


Figure 15. *Coefficient comparison plot from final generalized linear mixed models for the association between jail-based opioid agonist treatment policies and opioid-specific overdose rates – 2005-2020*

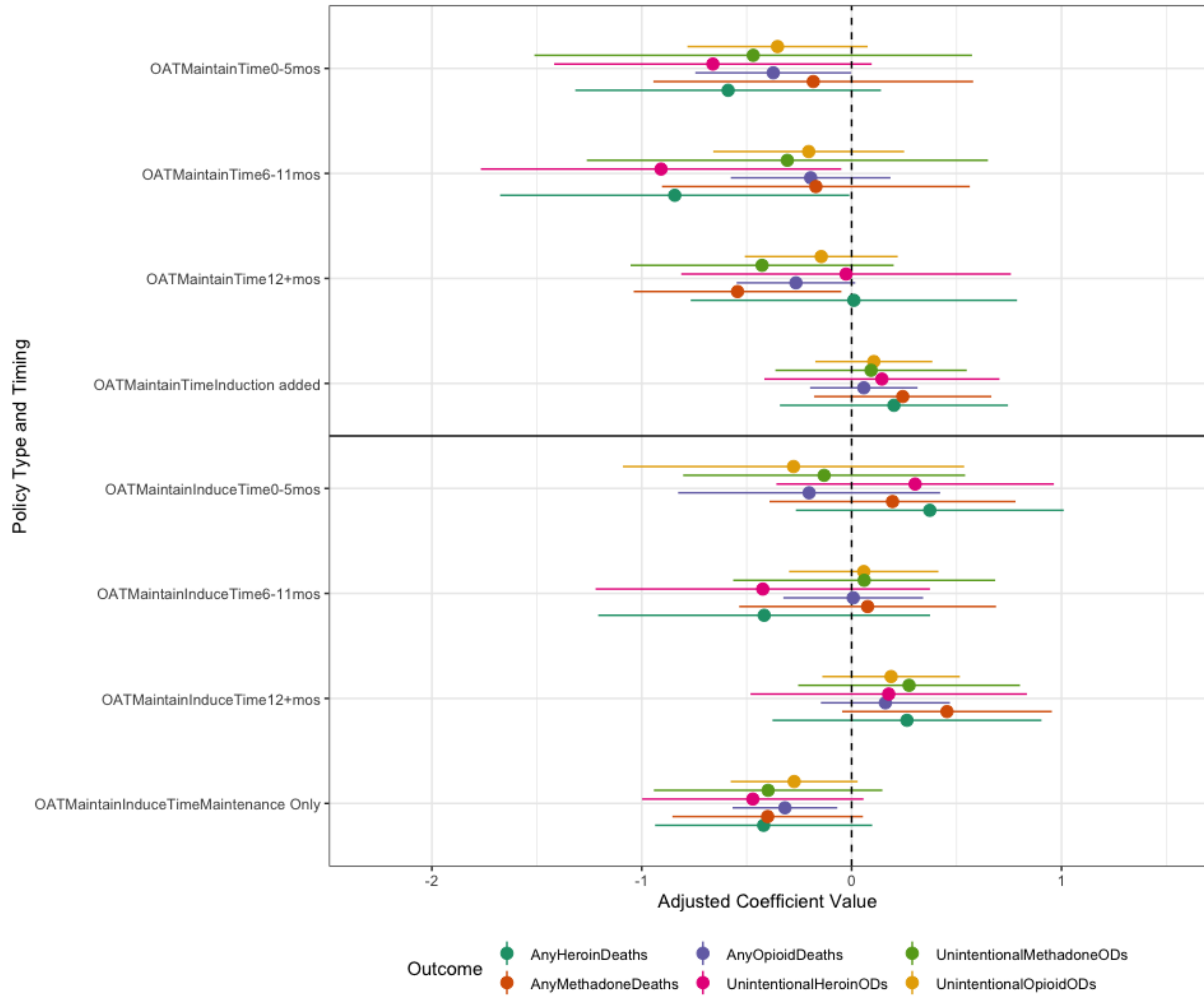

Policy Type and Timing
OATMaintainTime0-5mos
OATMaintainTime6-11mos
OATMaintainTime12+mos
OATMaintainTimeInduction added
OATMaintainInduceTime0-5mos
OATMaintainInduceTime6-11mos
OATMaintainInduceTime12+mos
OATMaintainInduceTimeMaintenance Only
-2
-1
0
1
Adjusted Coefficient Value
Outcome
AnyHeroinDeaths
AnyMethadoneDeaths
AnyOpioidDeaths
UnintentionalHeroinODs
UnintentionalMethadoneODs
UnintentionalOpioidODs

Table 6. *Incidence rate ratios and 95% confidence intervals for comparison between opioid-specific and drug overdose deaths for a study of jail-based opioid agonist treatment policies in 26 California counties – 2005-2018*

	All Drug Overdoses		**All Opioid-related Deaths**		**Accidental Drug Overdoses**		**Accidental Opioid Overdoses**		**Intentional Drug Overdoses**		**Intentional Opioid Overdoses**	
Jail-based Policy Category	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	0.77 (0.55 – 1.09)	0.15	0.69 (0.47 – 1.00)	**0.05**	0.78 (0.59 – 1.04)	0.09	0.70 (0.46 – 1.08)	0.11	1.00 (0.54 – 1.87)	0.99	0.72 (0.26 – 1.99)	0.52
OAT Maintenance: 6-11 Months	0.90 (0.69 – 1.17)	0.43	0.82 (0.56 – 1.20)	0.31	0.91 (0.67 – 1.24)	0.56	0.81 (0.52 – 1.28)	0.38	1.25 (0.71 – 2.20)	0.44	0.98 (0.41 – 2.35)	0.97
OAT Maintenance: 12+ Months	0.96 (0.73 – 1.27)	0.78	0.77 (0.58 – 1.02)	0.07	1.15 (0.80 – 1.66)	0.45	0.87 (0.60 – 1.25)	0.44	0.98 (0.56 – 1.71)	0.94	0.54 (0.31 – 0.95)	**0.03**
OAT Maintenance with Induction Added	1.07 (0.76 – 1.51)	0.69	1.06 (0.82 – 1.37)	0.66	1.18 (0.82 – 1.69)	0.38	1.11 (0.84 – 1.47)	0.46	0.81 (0.53 – 1.22)	0.31	1.04 (0.66 – 1.63)	0.88
OAT Maintenance and Induction: 0-5 Months	1.08 (0.87 – 1.35)	0.49	0.82 (0.44 – 1.52)	0.52	1.08 (0.71 – 1.62)	0.73	0.76 (0.34 – 1.71)	0.50	0.66 (0.31 – 1.39)	0.27	1.01 (0.35 – 2.91)	0.99
OAT Maintenance and Induction: 6-11 Months	0.98 (0.77 – 1.24)	0.87	1.01 (0.72 – 1.41)	0.96	1.03 (0.78 – 1.37)	0.81	1.06 (0.74 – 1.51)	0.75	0.70 (0.34 – 1.43)	0.33	0.50 (0.12 – 2.14)	0.35
OAT Maintenance and Induction: 12+ Months	1.45 (1.19 – 1.77)	**<0.001**	1.17 (0.86 – 1.60)	0.30	1.52 (1.19 – 1.96)	**<0.001**	1.21 (0.87 – 1.67)	0.26	1.17 (0.65 – 2.12)	0.60	1.35 (0.68 – 2.67)	0.39
OAT Maintenance Only	0.96 (0.81 – 1.14)	0.64	0.73 (0.57 – 0.93)	**0.01**	0.99 (0.78 – 1.27)	0.96	0.76 (0.56 – 1.03)	0.08	1.07 (0.78 – 1.48)	0.66	0.62 (0.36 – 1.08)	0.09

Table 7. *Incidence rate ratios and 95% confidence intervals for the association between jail-based opioid agonist treatment policies and county-level opioid-specific overdose rates in 26 California counties – 2005-2018*

	All Methadone-involved Deaths		**Accidental Methadone Overdose Deaths**		**All Heroin-involved Deaths**		**Accidental Heroin Overdose Deaths**	
Jail-based Policy Category	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	0.83 (0.39 – 1.78)	0.64	0.63 (0.22 – 1.77)	0.38	0.56 (0.27 – 1.15)	0.11	0.52 (0.24 – 1.10)	0.09
OAT Maintenance: 6-11 Months	0.84 (0.41 – 1.76)	0.65	0.74 (0.28 – 1.91)	0.53	0.43 (0.19 – 0.99)	**0.05**	0.40 (0.17 – 0.95)	**0.04**
OAT Maintenance: 12+ Months	0.58 (0.35 – 0.95)	**0.03**	0.65 (0.35 – 1.22)	0.18	1.01 (0.46 – 2.20)	0.98	0.97 (0.44 – 2.14)	0.95
OAT Maintenance with Induction Added	1.28 (0.84 – 1.95)	0.26	1.10 (0.70 – 1.73)	0.69	1.22 (0.71 – 2.11)	0.47	1.16 (0.66 – 2.02)	0.61
OAT Maintenance and Induction: 0-5 Months	1.22 (0.68 – 2.18)	0.51	0.88 (0.45 – 1.72)	0.70	1.45 (0.77 – 2.75)	0.25	1.35 (0.70 – 2.62)	0.37
OAT Maintenance and Induction: 6-11 Months	1.08 (0.59 – 1.99)	0.81	1.06 (0.57 – 1.98)	0.85	0.66 (0.30 – 1.45)	0.30	0.65 (0.30 – 1.45)	0.30
OAT Maintenance and Induction: 12+ Months	1.58 (0.96 – 2.60)	0.07	1.31 (0.78 – 2.23)	0.31	1.30 (0.69 – 2.47)	0.42	1.19 (0.62 – 2.31)	0.60
OAT Maintenance Only	0.67 (0.43 – 1.06)	0.08	0.67 (0.39 – 1.16)	0.15	0.66 (0.39 – 1.10)	0.11	0.62 (0.37 – 1.06)	0.08

Outcome: Emergency Department Visits

Crude opioid-related and overdose emergency department visit rates by county showed variability in their magnitude, likely related to population size and differences in population-level drug use habits between urban and rural counties (**Figures 16, 17**). While the rate of primary diagnosis opioid-related ED visits has remained relatively flat, some counties began experiencing increases around 2017. In contrast, overdose ED visit rates have been gradually increasing since 2005. San Francisco and Mendocino counties appeared to experience the most dramatic increase in rates after 2017 as compared to other counties.

Figure 16. *Primary diagnosis opioid-related emergency department (ED) visit rates per 100,000 residents for 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

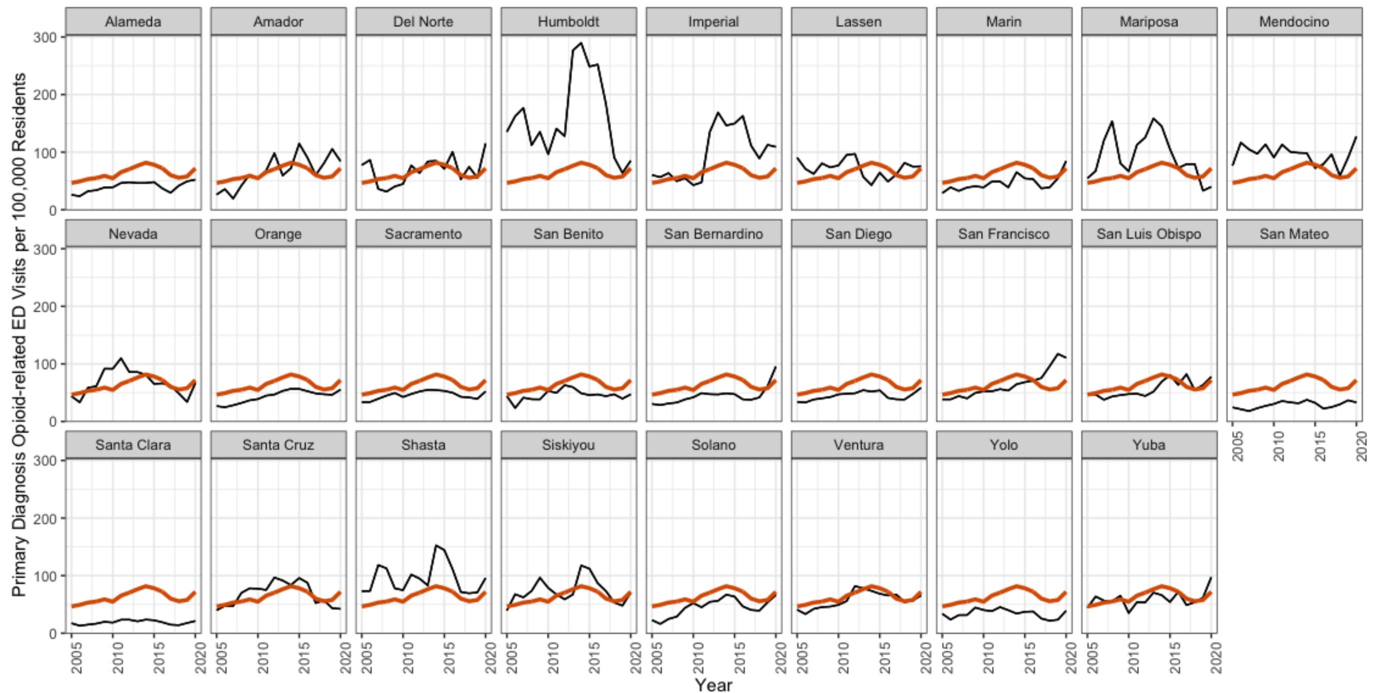


Figure 17. *Primary diagnosis overdose emergency department (ED) visit rates per 100,000 residents for 26 California counties included in a study of jail-based medication for opioid use disorder treatment programs– 2005-2020*

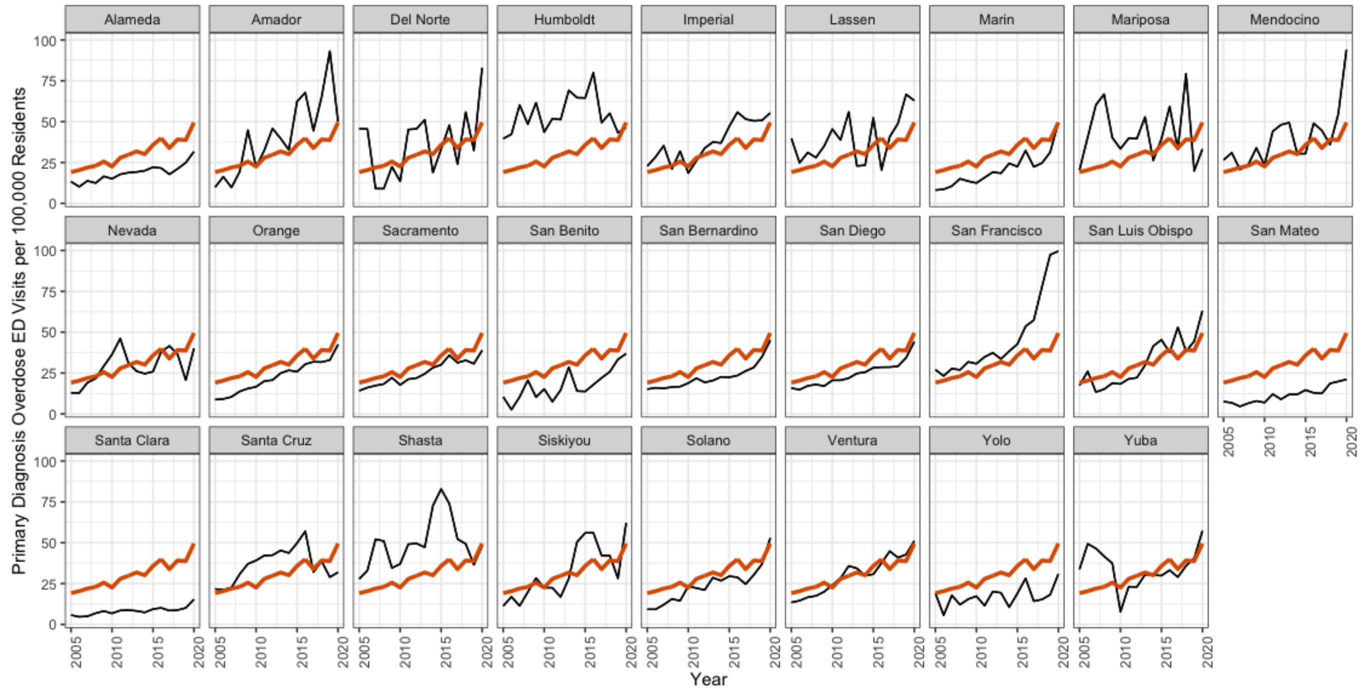


Figure 18 displays the crude primary diagnosis opioid-related emergency department visit rate per 100,000 residents by exposure category from 2005 to 2020. Similar to the relationship observed for drug overdose deaths, counties with jail-based OAT maintenance and induction policies started with higher population-level opioid-related ED visit rates than counties with OAT maintenance only policies or those with no OAT. As noted above, this increase may be driven by large urban counties like San Francisco contributing a lot of OAT maintenance and induction exposure-time and concurrently experiencing high drug overdose death rates due to fentanyl contamination and shifts in drug use habits. Additionally, after a period of decreasing rates, counties with OAT maintenance and induction policies began experiencing increases in opioid-related ED visit rates in 2017 with a peak around 2019 resulting in decreasing trends in 2020.

Figure 18. *Crude primary diagnosis opioid-related emergency department (ED) visit rates per 100,000 residents by exposure categories overtime in 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

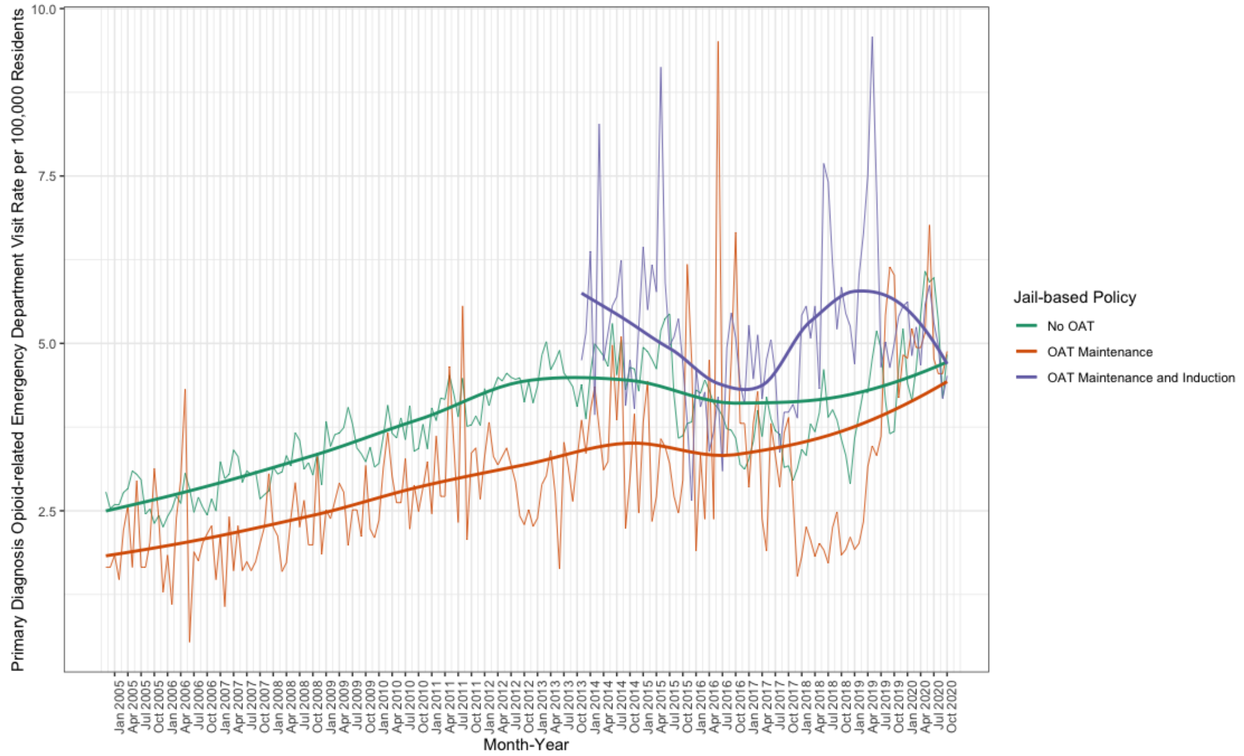
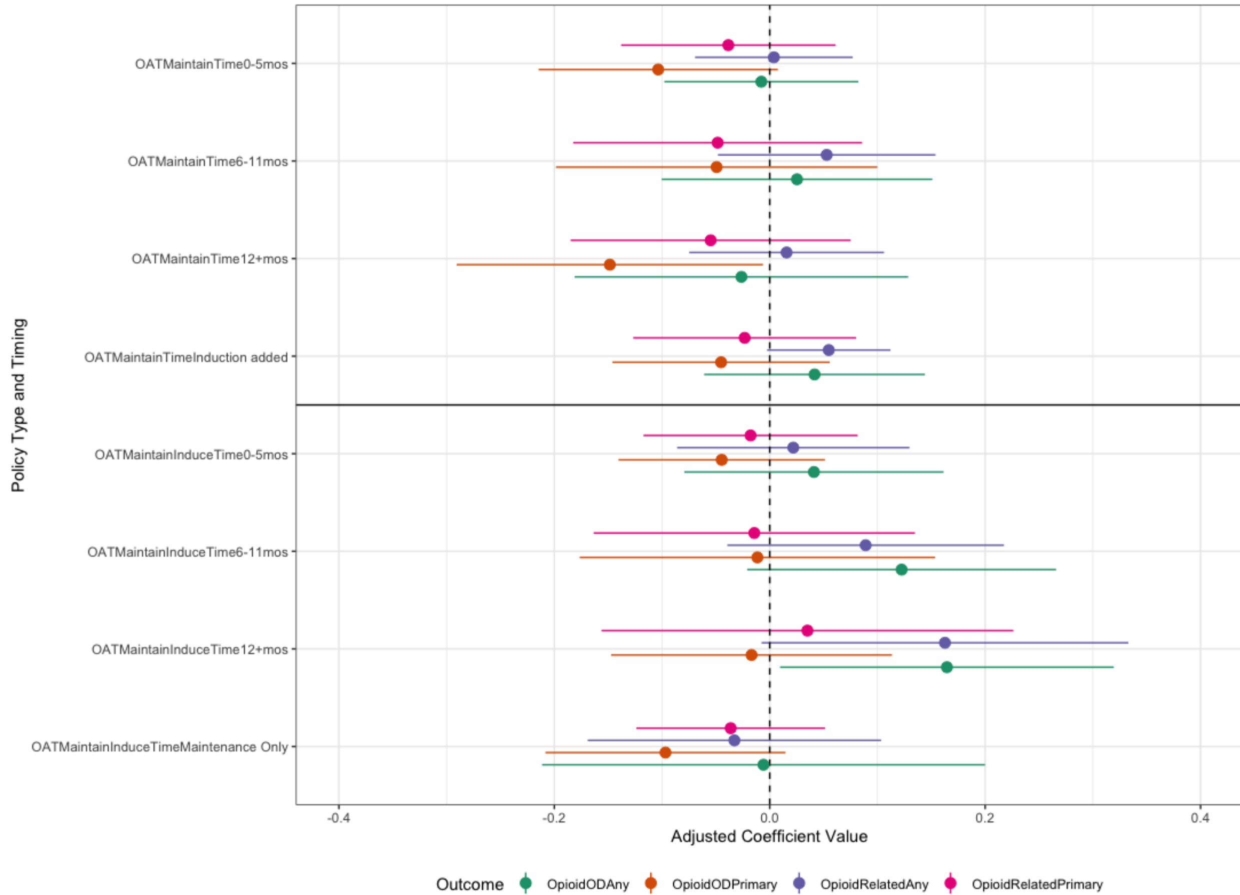


Figure 19. *Coefficient comparison plot from final generalized linear mixed models for the association between jail-based opioid agonist treatment policies and emergency department visit rates by county of residence – 2005-2020*



Final model coefficients and adjusted incident rate ratios for ED visit outcomes are displayed in **Figure 19** and **Table 8**. We observed that counties with OAT maintenance and induction policies for 12 months or more saw an increase of 18% in their rates of any overdose diagnosis ED visits (95% CI: 1-38%) as compared to counties without OAT. In contrast, counties with OAT maintenance only policies for 12 or more months observed a 14% decrease in their primary overdose diagnosis ED visit rate compared to counties with no OAT (95% CI: 1-25%).

Table 8. *Incidence rate ratios and 95% confidence intervals for the association between jail-based opioid agonist treatment policies and county-level opioid-related emergency department visit rates by county of residence in 26 California counties – 2005-2020*

	Any Overdose Diagnosis		**Primary Overdose Diagnosis**		**Any Opioid-Related Diagnosis**		**Primary Opioid-Related Diagnosis**	
Jail-based Policy Category	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*	*IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	0.99 (0.91 – 1.09)	0.87	0.90 (0.81 – 1.01)	0.07	1.00 (0.93 – 1.08)	0.92	0.96 (0.87 – 1.06)	0.45
OAT Maintenance: 6-11 Months	1.03 (0.90 – 1.16)	0.69	0.95 (0.82 – 1.11)	0.52	1.05 (0.95 – 1.17)	0.30	0.95 (0.83 – 1.09)	0.48
OAT Maintenance: 12+ Months	0.97 (0.83 – 1.14)	0.74	0.86 (0.75 – 0.99)	**0.04**	1.02 (0.93 – 1.11)	0.73	0.95 (0.83 – 1.08)	0.41
OAT Maintenance with Induction Added	1.04 (0.94 – 1.15)	0.43	0.96 (0.86 – 1.06)	0.38	1.06 (1.00 – 1.12)	0.06	0.98 (0.88 – 1.08)	0.66
OAT Maintenance and Induction: 0-5 Months	1.04 (0.92 – 1.18)	0.50	0.96 (0.87 – 1.05)	0.36	1.02 (0.92 – 1.14)	0.69	0.98 (0.89 – 1.09)	0.73
OAT Maintenance and Induction: 6-11 Months	1.13 (0.98 – 1.30)	0.09	0.99 (0.84 – 1.17)	0.89	1.09 (0.96 – 1.24)	0.17	0.99 (0.85 – 1.14)	0.85
OAT Maintenance and Induction: 12+ Months	1.18 (1.01 – 1.38)	**0.04**	0.98 (0.86 – 1.12)	0.80	1.18 (0.99 – 1.40)	0.06	1.04 (0.86 – 1.25)	0.72
OAT Maintenance Only	0.99 (0.81 – 1.22)	0.96	0.91 (0.81 – 1.01)	0.09	0.97 (0.84 – 1.11)	0.64	0.96 (0.88 – 1.05)	0.42

Outcome: Hospitalizations

Crude opioid-related and overdose hospitalization rates by county were smaller in magnitude than those for ED visits, as expected given that hospitalization is a more severe outcome (**Figures 20, 21**). Trends in the rate of primary diagnosis opioid-related hospitalizations are very similar across all study counties with the exception of Mendocino County, which appeared to have an increasing rate between 2010 and 2015 that has since declined. In contrast to the increase in rates observed for primary diagnosis overdose ED visits, hospitalizations due to overdoses have remained relatively stable throughout the study period, with some declines in recent years. There was more variability by county in the rate of overdose hospitalizations than there was for opioid-related hospitalizations.

Figure 20. *Primary diagnosis opioid-related hospitalization rates per 100,000 residents for 26 California counties included in a study of jail-based medication for opioid use disorder treatment programs– 2005-2020*

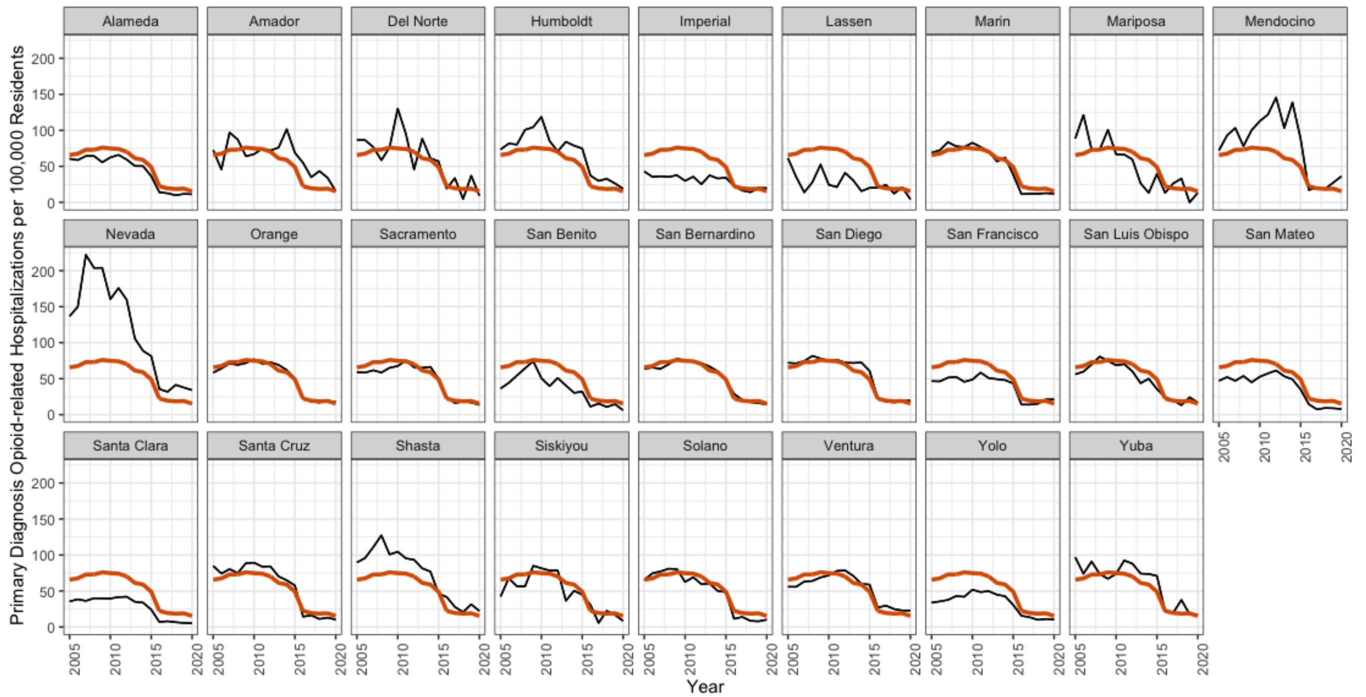


Figure 21. *Primary diagnosis overdose hospitalization rates per 100,000 residents for 26 California counties included in a study of jail-based opioid agonist treatment programs– 2005-2020*

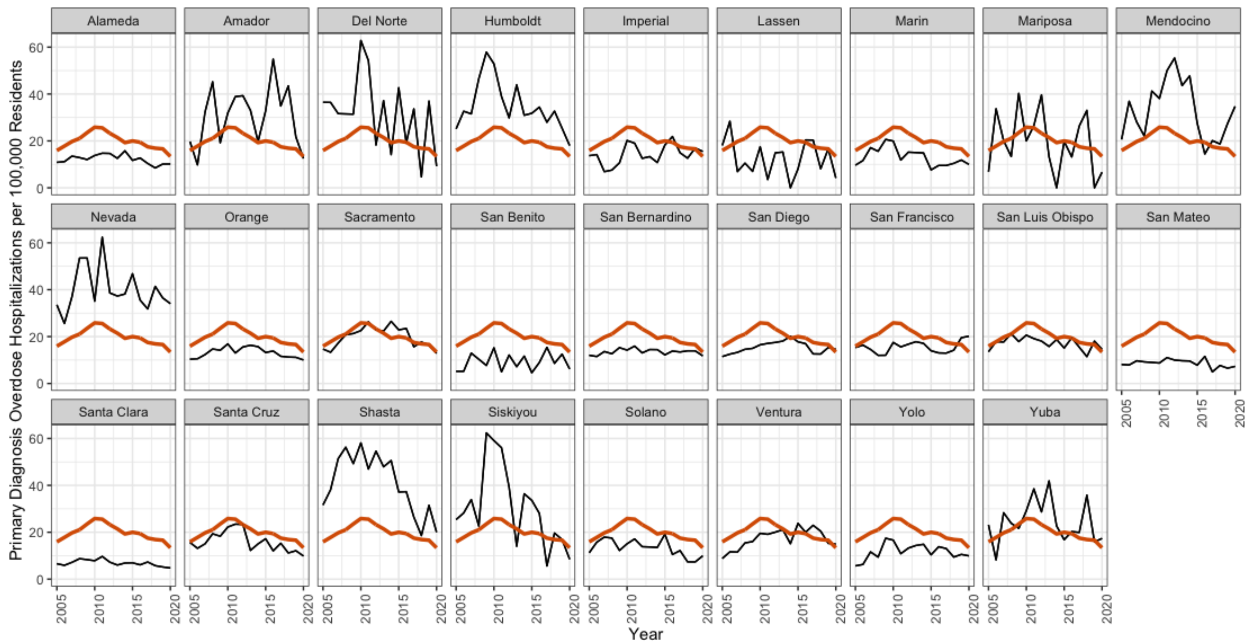


Figure 22 displays the crude primary diagnosis opioid-related hospitalization rate per 100,000 residents by exposure category from 2005 to 2020. Unlike contrasting relationships observed for other outcomes, the rates of opioid-related hospitalizations for exposure category follow a

similar trajectory. However, counties with jail-based OAT maintenance and induction policies experienced a more pronounced downward trend than other exposure groups leading up to 2017 that then began increasing.

Figure 22. *Crude primary diagnosis opioid-related hospitalization rates per 100,000 residents by exposure categories overtime in 26 California counties included in a study of jail-based opioid agonist treatment programs – 2005-2020*

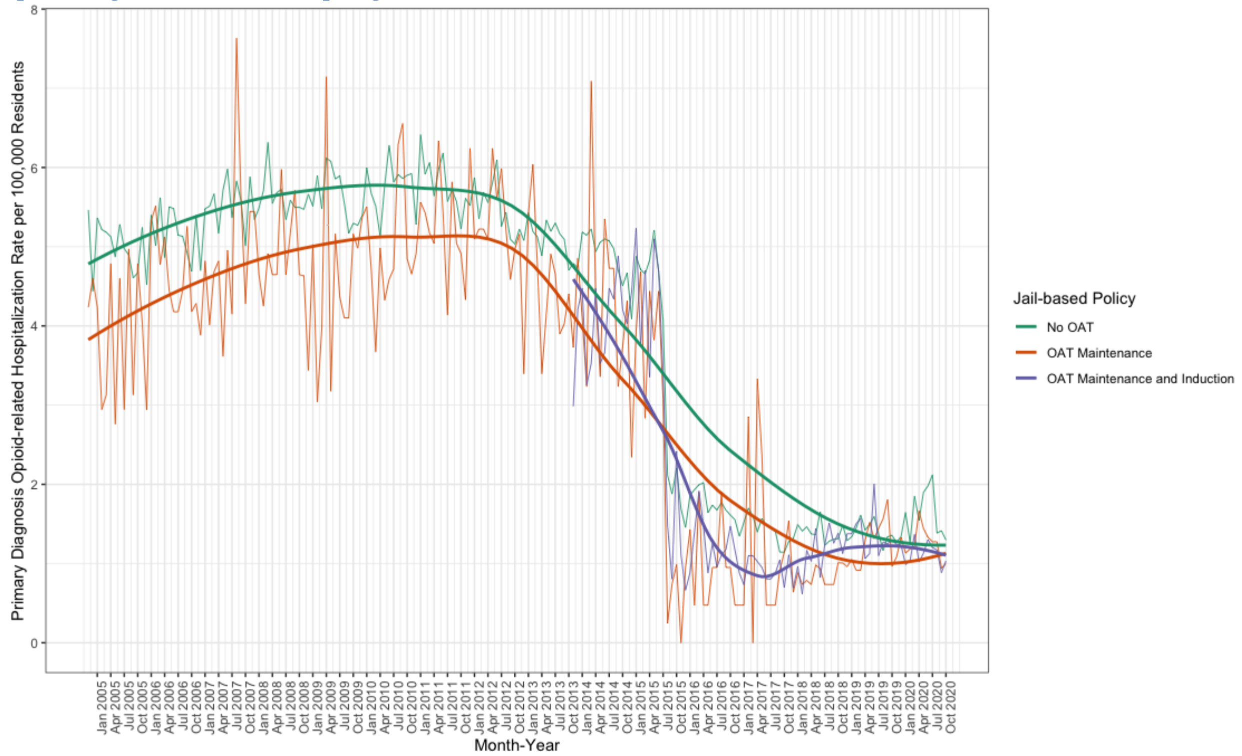
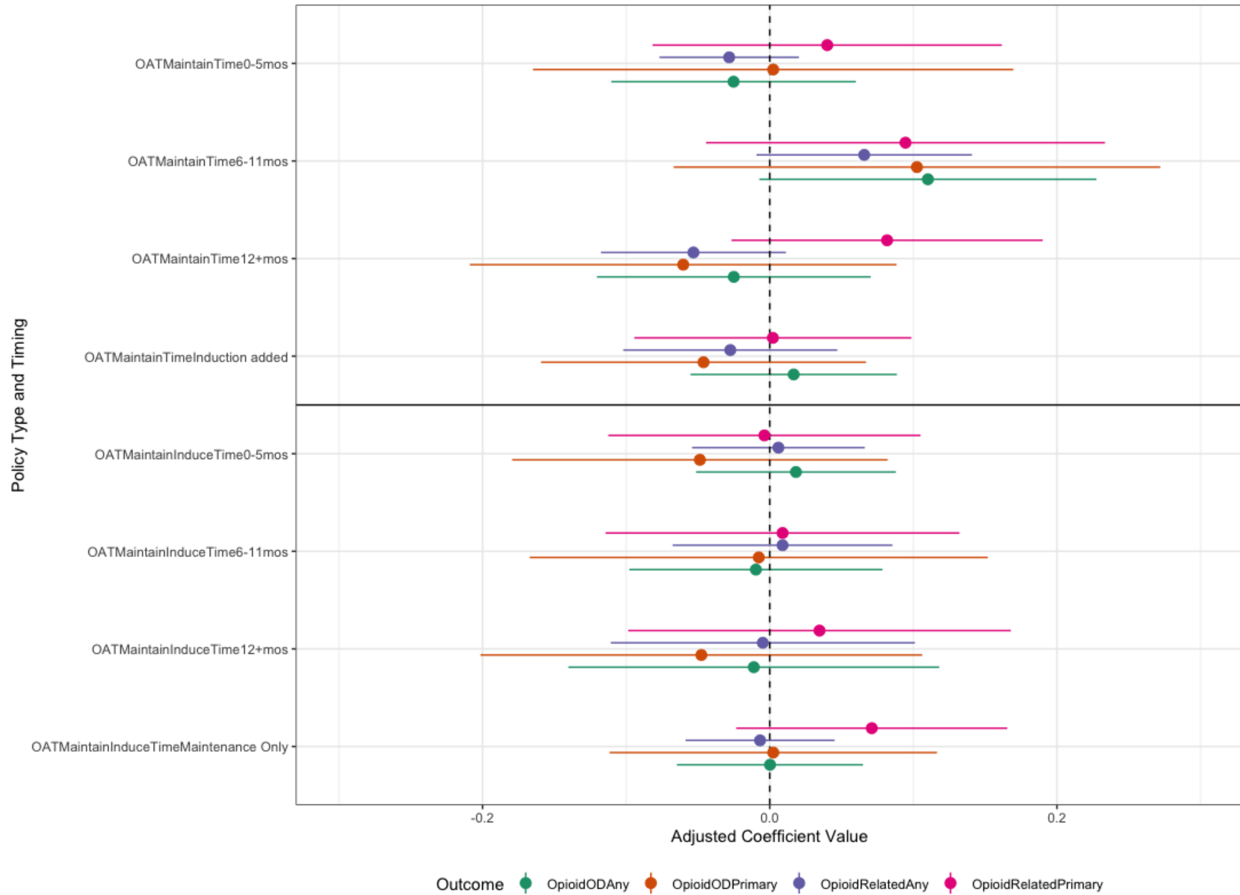


Figure 23. *Coefficient comparison plot from final generalized linear mixed models for the association between jail-based opioid agonist treatment policies and hospitalization rates by county of residence – 2005-2020*



Final model coefficients and incident rate ratios for hospitalization outcomes are displayed in **Figure 23** and **Table 9**. We did not observe any statistically significant relationships between county-level, opioid-related hospitalization rates and jail-based OAT maintenance or induction policies.

Table 9. *Incidence rate ratios and 95% confidence intervals for the association between jail-based opioid agonist treatment policies and county-level opioid-related hospitalization rates by county of residence in 26 California counties – 2005-2020*

Jail-based Policy Category	**Any Overdose Diagnosis** *IRR (95% CI)*	*p*	**Primary Overdose Diagnosis** *IRR (95% CI)*	*p*	**Any Opioid-Related Diagnosis** *IRR (95% CI)*	*p*	**Primary Opioid-Related Diagnosis** *IRR (95% CI)*	*p*
OAT Maintenance: 0-5 Months	0.98 (0.90 – 1.06)	0.56	1.00 (0.85 – 1.18)	0.98	0.97 (0.93 – 1.02)	0.25	1.04 (0.92 – 1.18)	0.52
OAT Maintenance: 6-11 Months	1.12 (0.99 – 1.26)	0.07	1.11 (0.94 – 1.31)	0.24	1.07 (0.99 – 1.15)	0.09	1.10 (0.96 – 1.26)	0.18
OAT Maintenance: 12+ Months	0.98 (0.89 – 1.07)	0.61	0.94 (0.81 – 1.09)	0.43	0.95 (0.89 – 1.01)	0.11	1.09 (0.97 – 1.21)	0.14
OAT Maintenance with Induction Added	1.02 (0.95 – 1.09)	0.65	0.95 (0.85 – 1.07)	0.42	0.97 (0.90 – 1.05)	0.47	1.00 (0.91 – 1.10)	0.96
OAT Maintenance and Induction: 0-5 Months	1.02 (0.95 – 1.09)	0.61	0.95 (0.84 – 1.09)	0.47	1.01 (0.95 – 1.07)	0.84	1.00 (0.89 – 1.11)	0.95
OAT Maintenance and Induction: 6-11 Months	0.99 (0.91 – 1.08)	0.83	0.99 (0.85 – 1.16)	0.93	1.01 (0.93 – 1.09)	0.82	1.01 (0.89 – 1.14)	0.89
OAT Maintenance and Induction: 12+ Months	0.99 (0.87 – 1.13)	0.87	0.95 (0.82 – 1.11)	0.54	1.00 (0.90 – 1.11)	0.93	1.04 (0.91 – 1.18)	0.61
OAT Maintenance Only	1.00 (0.94 – 1.07)	1.00	1.00 (0.89 – 1.12)	0.97	0.99 (0.94 – 1.05)	0.80	1.07 (0.98 – 1.18)	0.14

Discussion

We characterized jail-based treatment policies for 26 counties in California using one-on-one interviews and an electronic survey in what is the first study, to our knowledge, to evaluate these policies at the population-level in a multi-county study. As has been observed nationwide, we captured an increasing trend in offering OAT in county jails in this study, with 19 out of 26 counties offering some form of OAT in their jails by 2020. For counties with jail-based OAT policies, we observed population-level increases in drug arrests, non-drug convictions, and property convictions and decreases in overall arrests and non-drug arrests. We observed differences in some of these relationships by policy type (OAT maintenance only, OAT maintenance and induction). Counties with OAT maintenance and induction policies for 12 months or more observed increases in their population-level rates of any overdose diagnosis ED visits, while counties with OAT maintenance only policies for 12+ months saw a reduction in primary diagnosis overdose ED visits. While we did not identify a relationship between county-level drug overdose rates and jail-based OAT policies in primary analyses, we did observe decreases in opioid-related deaths, heroin overdose deaths, and methadone-involved deaths when examining outcomes from 2005-2018.

Some of the differences in outcomes observed between jail-based OAT maintenance only and OAT maintenance and induction policies may be explained by the opioid agonists used by jails implementing these programs. Most of the county jails offering OAT inductions used buprenorphine, with the exception of one. In contrast, many OAT maintenance policies included maintenance of both buprenorphine and methadone treatment. Emerging research suggests that because buprenorphine is a partial agonist, meaning it only partially binds to the μ-opioid receptor, it may not appropriately prevent fentanyl from binding to this receptor and can be contraindicated due to precipitating severe withdrawal in people who use fentanyl or have a fentanyl use disorder.[100] While some have suggested protocols to reduce this risk,[101,102] it's unclear if jails would be using these advanced protocols given that they were in early stages of policy implementation. The discordant results for population-level ED visit rates is one example of how this may be influencing our results: we observed significant increases in population-level rates of any overdose diagnosis ED visits among counties with OAT maintenance and induction policies, while also observing a significant decrease in the primary overdose diagnosis rate in counties with OAT maintenance only policies. However, this difference in outcomes may also be due to fentanyl contaminating the illegal drug supply and increasing fentanyl use resulting in elevated overdose risk. Many counties implemented jail-based OAT maintenance and induction policies between 2017-2020 when fentanyl was very prevalent in California.

We observed a population-level increase in drug arrests, non-drug convictions, and property convictions in counties with jail-based OAT policies. There were many laws and regulations in California that influenced drug-related arrest and conviction rates, including legalization of recreational marijuana use, Prop 47, as described above, and decarceration during the COVID-19 pandemic. We were unable to evaluate opioid-specific arrest and conviction rates because the California Department of Justice does not systematically code the drugs involved in arrests and convictions. Given these significant policy changes, we may be observing shifts in arrests or convictions due to changes in the use and legalization of other drugs. Advocacy is needed to improve data collection and availability for drug-related arrests to better evaluate the impact these policies have on opioid-specific CLS outcomes.[103] We also observed decreases in arrest

rates, generally, and non-drug arrest rates, suggesting there may be a population-level impact of jail-based OAT policies on broader arrest outcomes.

All drug overdose deaths were used as the primary fatal overdose outcome to capture more recent exposure-time in counties who recently implemented jail-based OAT policies and because multiple cause of death data were not available for 2019-2020. We may not have examined a relationship between jail-based OAT policies and county-level drug overdose death rates because OAT policies influence opioid-related deaths most and may not be influencing fatal overdoses due to other substances. Another possibility is that fentanyl has resulted in dramatically increasing drug overdose rates that offset any potential reduction expected from jail-based OAT policies. Sensitivity analyses evaluating the impact of these policies on opioid-related deaths found statistically significant reductions in opioid-related, methadone-involved, and heroin overdose deaths, suggesting that the former may be explaining the null findings for drug overdose death rates.

This study has several limitations, as well as strengths. Some counties in California experience a large amount of movement between administrative barriers, which in some cases is inherently linked to their CLS and jail practices. Nearly all counties included in this study noted that they had inmates from neighboring counties, with some counties near tourist sites or large cities experiencing more movement. This movement may have impacted our ability to identify a population-level impact as most of our indicators were based on county of residence. We conducted sensitivity analyses based on county of occurrence for ED visit, hospitalization, and death outcomes and did not find that it meaningfully impacted primary results. However, the adult population of each county may not be the appropriate population at risk for a true population-level rate of arrests and convictions, resulting in potentially inflated estimates in counties with a lot of movement and spuriously low estimates in counties with low movement between borders. Secondly, many counties did not offer OAT maintenance and induction in their jails prior to 2014, meaning that there may not have been enough time to observe this exposure's impact on opioid-related health outcomes and arrests. Furthermore, in 2016-2017, a time when many counties implemented OAT policies in their jails, fentanyl-related overdoses began exceeding heroin-related overdoses in many California jurisdictions. Therefore, we may be observing a cohort effect particularly for OAT maintenance and induction policies whereby there is little pre-fentanyl exposure time to observe the impact these policies had in absence of exponentially high overdose rates. Because it is the most prevalent health outcome, we would expect ED visit rates to be most sensitive to this issue, and we observed a statistically significant increase in population-level overdose-related ED visits in counties with OAT maintenance and induction policies while also observing a decrease in overdose-related ED visits in counties with OAT maintenance only policies. This discordant finding suggests that we may have a cohort effect in our evaluation of jail-based OAT maintenance and induction policies. Lastly, there may be a lagged impact of jail-based OAT policies on these population-level outcomes. Primary analyses used the month/year the policy was reported as fully implemented as the policy start date. Future sensitivity analyses will evaluate how a lag of 3 and 6 months will influence these relationships observed.

Evaluating the effect of policies on health outcomes generally define the policy and exposure-time based on legislative documents. However, there may be county-level policies and programs

integrating medications for OUD into the CLS that are not well documented in the literature or in policy databases. This motivated our decision to interview stakeholders from counties in California directly about their practices to characterize their jail-based policy. A recent national-level study took a similar approach to characterize prison MOUD policies in several US states.[104] As a validation of this technique, we reviewed a report providing a national snapshot of jail-based MOUDs by state authored by the O'Neill Institute for National and Global Health Law at Georgetown University. This report listed several counties as having jail-based MOUD programs that we determined did not have them in place through interviews with key stakeholders. The report largely used participation in a state grant program aimed at expanding access to MOUD in county jails as an indication that grant-funded counties offered MOUD. However, counties participating in this grant program are at various stages of implementation. This validates our theory that interviewing key stakeholders working in these counties likely resulted in less misclassification of this particular exposure than if we had used published policies information alone. However, interviewing key stakeholders is also sensitive to the individual that was reached within each county. While we asked contacts to connect us to the most appropriate contact in their jurisdiction, additional information may have been learned by interviewing more stakeholders. Stakeholders were also asked to estimate the month/year when their county began offering MOUD in the jail and when the program was at scale. Some stakeholders did not have exact policy dates, so we may also have some misclassification of when a policy started. Future work will include reaching back out to stakeholders to confirm the policy characterization used for their county in this study and conducting sensitivity analyses varying the policy start month.

In this study, we observed that jail-based OAT policies largely led to either no effect or a reduction in opioid-related health outcomes. While mixed effects were observed for impacts on the CLS, arrests and convictions may be influenced by the availability of OAT in jails; CLS practitioners may have a perception that arresting or convicting someone who is using drugs will help them if it assists their transition into treatment via incarceration. At minimum, jail-based OAT policies do not change existing population-level outcomes dramatically while also reducing important outcomes like methadone and heroin-related deaths. Jails should increasingly implement OAT given the potential harm to those incarcerated who use drugs. Several studies have described implementation and sustainment frameworks for integrating these policies into the CLS, providing resources for CLS practitioners to address implementation challenges and highlighting the creative workarounds jails are using in the face of challenging economic and regulatory policies for MOUD.[56,105,106] This study offers insight on the population-level impact of jail-based MOUD policies at a level of interest to policymakers and poses questions about the evaluation of these policies in a time where opioid-related health outcomes are dramatically increasing due to fentanyl contamination. Further research is needed to elucidate these relationships, including replication in other settings.

Overall Conclusions and Implications

This dissertation evaluated the impact of jail-based OAT policies on the user and at the county-level. PWUD and were formerly incarcerated that participated in our study were largely supportive of MOUD, with the most support for buprenorphine. These individuals also described facing stigma and discrimination from the CLS, some of which also translated to how they felt about themselves and MOUD. For example, many participants supported the idea that using MOUD trades one addiction for another and abstinence as the ultimate goal of treatment. Further work is needed to address stigma within and outside of the community of PWUD. In Aim 1, we

identified several barriers to initiating treatment, including cost, logistics, fear/mistrust of service providers, violence, stigma, and structural forces like racism and sexism. Several potential policies and programs were suggested by study participants to address these barriers, including availability of programs led by people with lived experience of drug use in jails and providing more warm connections to service and treatment providers at the time of release from jail. People who use drugs and were formerly incarcerated described significant stigma and discrimination faced by the CLS which was more concentrated among people identify as Black, Hispanic/Latino/a, Native American, Multi-racial, or Multi-ethnic. To further explore this phenomenon, a future analysis will observe if there are any differences in how jail-based OAT policies impact population-level rates of health and CLS outcomes by race and ethnicity. This study also served as one potential framework for integrating the voices of PWUD into policy and program development. Other models of engagement center PWUD as key leaders in developing and implementing drug-related policies recognizing the unique expertise they have about the drug supply, drug use, and engaging meaningfully with PWUD. The Marin County Department of Health and Human Services has launched a project focused on human-centered design to prevent overdoses among people experiencing homelessness. This process involves several semi-structured meetings with unhoused community members to solicit ideas for programs to address overdoses and other service needs and also includes two people with lived experience of drug use on the primary leadership committee. An extension of this study will be sharing the results back to the community of PWUD with the hopes of replicating the human-centered design process described above.

Aim 2 served as the first multi-county study, to our knowledge, to evaluate the population-level impact of jail-based OAT policies on health and CLS outcomes. This study also ascertained jail-based OAT policies via interviews with key stakeholders, providing a potential framework for accessing policy information that is not publicly available for use in quasi-experimental studies. We observed significant decreases in the population-level rates of arrests, non-drug arrests, opioid-related deaths, heroin overdose deaths, methadone-related deaths. Given the significant risk in overdose deaths, implementation of jail-based OAT policies may serve to curb the exponential increase in opioid-related deaths. However, given the unique treatment challenges fentanyl presents, specialized protocols may be needed to ensure these policies have the greatest impact.

References

1. National Center for Health Statistics. *10 Leading Causes of Injury Deaths by Age Group Highlighting Unintentional Injury Deaths, United States - 2016.*; 2016.

2. Centers for Disease Control and Prevention. *2018 Annual Surveillance Report of Drug-Related Risks and Outcomes - United States.*; 2018.

3. Winkelman TNA, Chang VW, Binswanger IA. Health, Polysubstance Use, and Criminal Justice Involvement Among Adults With Varying Levels of Opioid Use. 2018;1(3):2-13. doi:10.1001/jamanetworkopen.2018.0558

4. Binswanger IA. Perspective: Opioid Use Disorder and Incarceration - Hope for Ensuring the Continuity of Treatment. *N Engl J Med*. Published online 2019:1-3. doi:10.1056/NEJMp1900069

5. World Health Organization. *Preventing Overdose Deaths in the Criminal-Justice System.*; 2014.

6. Csete J. Criminal Justice Barriers to Treatment of Opioid Use Disorders in the United States : The Need for Public Health Advocacy. *Am J Public Health*. 2019;109(3):419-422. doi:10.2105/AJPH.2018.304852

7. Minton TD. Jail Inmates in 2020 – Statistical Tables. *Stat Tables*. Published online 2020:27.

8. Nielsen S, Larance B, Degenhardt L, et al. Opioid agonist treatment for pharmaceutical opioid dependent people (Review). *Cochrane Database Syst Rev*. 2016;Art. No.:(5). doi:10.1002/14651858.CD011117.pub2.Copyright

9. Moore KE, Roberts W, Reid HH, Smith KMZ, Oberleitner LMS, Mckee SA. Effectiveness of medication assisted treatment for opioid use in prison and jail settings: A meta-analysis and systematic review. *J Subst Abuse Treat*. 2019;99(December 2018):32-43. doi:10.1016/j.jsat.2018.12.003

10. Grady KEO, Kelly SM, Gryczynski J, Mitchell SG, Schwartz RP. Pharmacotherapy for opioid dependence in jails and prisons : research review update and future directions. Published online 2016:27-40.

11. Lee JD, Friedmann PD, Kinlock TW, et al. Extended-Release Naltrexone to Prevent Opioid Relapse in Criminal Justice Offenders. *N Engl J Med*. 2016;374(13):1232-1242. doi:10.1056/NEJMoa1505409.

12. Egli N, Pina M, Christensen PS, Aebi M, Killias M. Effects of Drug Substitution Programs on Offending among Drug-Addicts. *Campbell Syst Rev*. 2011;2009(3). doi:10.4073/csr.2009.3

13. Mitchell SG, Kelly SM, Brown BS, et al. Incarceration and opioid withdrawal: The experiences of methadone patients and out-of-treatment heroin users. *J Psychoact Drugs*. 2009;41(2):145-152.

14. Fox AD, Maradiaga J, Weiss L, Sanchez J, Starrels JL, Cunningham CO. Release from incarceration, relapse to opioid use and the potential for buprenorphine maintenance treatment: a qualitative study of the perceptions of former inmates with opioid use disorder. *Addict Sci Clin Pract*. 2015;10(1):2. doi:10.1186/s13722-014-0023-0

15. Binswanger IA, Stern MF, Deyo RA, et al. Release from Prison — A High Risk of Death for Former Inmates. *N Engl J Med*. 2007;356:157-165.

16. Substance Abuse and Mental Health Services Administration. *Key Substance Use and Mental Health Indicators in the United States: Results from the 2020 National Survey on Drug Use and Health (HHS Publication No. PEP21-07-01-003, NSDUH Series H-56)*. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration; 2021:156. Retrieved from https://www.samhsa.gov/data/

17. Bronson J, Stroop J, Zimmer S, Berzofsky M. *Drug Use, Dependence, and Abuse Among State Prisoners and Jail Inmates, 2007-2009.*; 2017.

18. Freudenberg N, Heller D. A Review of Opportunities to Improve the Health of People Involved in the Criminal Justice System in the United States. *Annu Rev Public Health*. 2016;37:313-333. doi:10.1146/annurev-publhealth-032315-021420

19. Bruce RD, Schleifer RA. Ethical and human rights imperatives to ensure medication-assisted treatment for opioid dependence in prisons and pre-trial detention. *Int J Drug Policy*. 2008;19(1):17-23. doi:10.1016/j.drugpo.2007.11.019

20. Wakeman SE. Why It's Inappropriate Not to Treat Incarcerated Patients with Opioid Agonist Therapy. *AMA J Ethics*. 2017;19(9):922-930.

21. Mattick RP, Breen C, Kimber J, Davoli M. Methadone maintenance therapy versus no opioid replacement therapy for opioid dependence. *Cochrane Database Syst Rev*. 2009;(3):CD002209. doi:10.1002/14651858.CD002209.pub2

22. Mattick RP, Breen C, Kimber J, Davoli M. Buprenorphine maintenance versus placebo or methadone maintenance for opioid dependence. *Cochrane Database Syst Rev*. 2014;(2):CD002207. doi:10.1002/14651858.CD002207.pub4

23. Moore KE, Roberts W, Reid HH, Smith KMZ, Oberleitner LMS, McKee SA. Effectiveness of medication assisted treatment for opioid use in prison and jail settings: A meta-analysis and systematic review. *J Subst Abuse Treat*. 2019;99:32-43. doi:10.1016/j.jsat.2018.12.003

24. S Nielsen, Larance B, Degenhardt L, Gowing L, Kehler C, Lintzeris N. Opioid agonist treatment for pharmaceutical opioid dependent people. *Cochrane Database Syst Rev 2016*. 2016;(5). doi:10.1002/14651858.CD011117.pub2

25. Sharma A, O'Grady KE, Kelly SM, Gryczynski J, Mitchell SG, Schwartz RP. Pharmacotherapy for opioid dependence in jails and prisons: research review update and future directions. *Subst Abuse Rehabil*. 2016;7:27-40. doi:10.2147/SAR.S81602

26. US Dept of Health and Human Services, Substance Abuse and Mental Health Services Administration (SAMHSA). Medication and Counseling Treatment [online fact sheet]. Published online 2015.

27. Substance Abuse and Mental Health Services Administration (SAMHSA). *Medications for Opioid Use Disorder For Healthcare and Addiction Professionals, Policymakers, Patients, and Families - TREATMENT IMPROVEMENT PROTOCOL (TIP 63)*.; 2018.

28. Larochelle MR, Bernson D, Land T, et al. Medication for Opioid Use Disorder After Nonfatal Opioid Overdose and Association With Mortality. *Ann Intern Med*. 2018;169(3):137-145. doi:10.7326/M17-3107

29. Pierce M, Bird SM, Hickman M, et al. Impact of treatment for opioid dependence on fatal drug-related poisoning: a national cohort study in England. *Addict Abingdon Engl*. 2016;111(2):298-308. doi:10.1111/add.13193

30. Wakeman SE, Larochelle MR, Ameli O, et al. Comparative Effectiveness of Different Treatment Pathways for Opioid Use Disorder. *JAMA Netw Open*. 2020;3(2):e1920622. doi:10.1001/jamanetworkopen.2019.20622

31. Krawczyk BN, Picher CE, Feder KA, Saloner B. Only One In Twenty Justice- Referred Adults In Specialty Treatment For Opioid Use Receive Methadone Or Buprenorphine. *Behav Health Care*. 2017;36(12):2046-2053. doi:10.1377/hlthaff.2017.0890

32. Nunn A, Zaller N, Dickman S, Trimbur C, Nijhawan A, Rich JD. Methadone and Buprenorphine Prescribing and Referral Practices in US Prison Systems: Results from a Nationwide Survey. 2009;105(1-2):83-88. doi:10.1016/j.drugalcdep.2009.06.015.Methadone

33. Fu JJ, Zaller ND, Yokell MA, Bazazi AR, Rich JD. Forced withdrawal from methadone maintenance therapy in criminal justice settings: A critical treatment barrier in the United States. *J Subst Abuse Treat*. 2013;44(5):502-505. doi:10.1016/j.jsat.2012.10.005

34. Binswanger IA, Stern MF, Deyo RA, et al. Release from Prison — A High Risk of Death for Former Inmates. *N Engl J Med*. 2007;356(2):157-165. doi:10.1056/NEJMsa064115

35. Merrall ELC, Kariminia A, Binswanger IA, et al. Meta-analysis of drug-related deaths soon after release from prison. *Addiction*. 2010;105(9):1545-1554. doi:10.1111/j.1360-0443.2010.02990.x

36. Ranapurwala SI, Shanahan ME, Alexandridis AA, et al. Opioid Overdose Mortality Among Former North Carolina Inmates: 2000–2015. *Am J Public Health*. 2018;108(9):1207-1213. doi:10.2105/AJPH.2018.304514

37. Winter RJ, Young JT, Stoové M, Agius PA, Hellard ME, Kinner SA. Resumption of injecting drug use following release from prison in Australia. *Drug Alcohol Depend*. 2016;168:104-111. doi:10.1016/j.drugalcdep.2016.08.640

38. Sordo L, Barrio G, Bravo MJ, et al. Mortality risk during and after opioid substitution treatment: systematic review and meta-analysis of cohort studies. *BMJ*. 2017;357:j1550. doi:10.1136/bmj.j1550

39. Lennox R, Martin L, Brimner C, O'Shea T. Hospital policy as a harm reduction intervention for people who use drugs. *Int J Drug Policy*. 2021;97:103324. doi:10.1016/j.drugpo.2021.103324

40. Salazar ZR, Vincent L, Figgatt MC, Gilbert MK, Dasgupta N. Research led by people who use drugs: centering the expertise of lived experience. *Subst Abuse Treat Prev Policy*. 2021;16:70. doi:10.1186/s13011-021-00406-6

41. Ti L, Tzemis D, Buxton JA. Engaging people who use drugs in policy and program development: A review of the literature. *Subst Abuse Treat Prev Policy*. 2012;7:47. doi:10.1186/1747-597X-7-47

42. Bryant J, Saxton M, Madden A, Bath N, Robinson S. Consumers' and providers' perspectives about consumer participation in drug treatment services: is there support to do more? What are the obstacles? *Drug Alcohol Rev*. 2008;27(2):138-144. doi:10.1080/09595230701829405

43. Motavalli D, Taylor JL, Childs E, et al. "Health Is on the Back Burner:" Multilevel Barriers and Facilitators to Primary Care Among People Who Inject Drugs. *J Gen Intern Med*. 2021;36(1):129-137. doi:10.1007/s11606-020-06201-6

44. US Census Bureau. *Decennial Census 2020*. US Census Bureau; 2021. Accessed March 18, 2022. https://data.census.gov/cedsci/table?q=marin%20county&tid=DECENNIALPL2020.P1

45. University of Wisconsin Population Health Institute. *County Health Rankings & Roadmaps 2021 - California*.; 2022. https://www.countyhealthrankings.org/app/california/2021/rankings/marin/county/outcomes/overall/snapshot

46. US Census Bureau. *2016-2020 American Community Survey 5-Year Estimates*. US Census Bureau; 2021.

47. Advancement Project California. *RACE COUNTS*. Advancement Project California; 2020. Accessed March 17, 2022. racecounts.org

48. RxSafe Marin and Marin County Health & Human Services. *RxSafe Marin Data Report Card*.; 2022. https://marincountyhhsdatahome.livestories.com/s/v2/rx-safe-marin-data-report-card/9a3df7e1-623b-4323-9392-23071bce4300/

49. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health*. 2015;42(5):533-544. doi:10.1007/s10488-013-0528-y

50. QSR International Pty Ltd. (2020) NVivo. Published online March 2020. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home?_ga=2.163353852.1330641469.1648929533-1429349929.1648929533

51. Miles M, Huberman A. *Qualitative Data Analysis: An Expanded Sourcebook*. Sage Publications; 2013.

52. Guest G, Mclellan E. Distinguishing the trees from the forest: applying cluster analysis to thematic qualitative data. *Field Methods*. 2003;15(1):186-201. doi:10.1177/1525822X03251188

53. Tashakkori A, Teddlie C. *Handbook of Mixed Methods in Social and Behavioral Research*. Sage Publications; 2003.

54. Creswell J, Plano Clark V. *Designing and Conducting Mixed Methods Research*. Sage Publications; 2007.

55. Banta-Green CJ, Floyd AS, Vick K, Arthur J, Hoeft TJ, Tsui JI. Opioid Use Disorder Treatment Decision Making And Care Navigation Upon Release From Prison: A Feasibility Study. *Subst Abuse Rehabil*. 2019;10:57-67. doi:10.2147/SAR.S192045

56. Banta-Green CJ, Williams JR, Sears JM, Floyd AS, Tsui JI, Hoeft TJ. Impact of a jail-based treatment decision-making intervention on post-release initiation of medications for opioid use disorder. *Drug Alcohol Depend*. 2020;207:107799. doi:10.1016/j.drugalcdep.2019.107799

57. van den Brink W, Haasen C. Evidence-Based Treatment of Opioid-Dependent Patients. *Can J Psychiatry*. 2006;51(10):635-646. doi:10.1177/070674370605101003

58. Favril L, Yu R, Hawton K, Fazel S. Risk factors for self-harm in prison: a systematic review and meta-analysis. *Lancet Psychiatry*. 2020;7(8):682-691. doi:10.1016/S2215-0366(20)30190-5

59. Kajeepeta S, Mauro PM, Keyes KM, El-Sayed AM, Rutherford CG, Prins SJ. Association between county jail incarceration and cause-specific county mortality in the USA, 1987–2017: a retrospective, longitudinal study. *Lancet Public Health*. 2021;6(4):e240-e248. doi:10.1016/S2468-2667(20)30283-8

60. National Action Alliance for Suicide Prevention: Transforming Health Systems Initiative Work Group. *Recommended Standard Care for People with Suicide Risk: Making Health Care Suicide Safe*. Education Development Center, Inc.; 2018.

61. Zhong S, Senior M, Yu R, et al. Risk factors for suicide in prisons: a systematic review and meta-analysis. *Lancet Public Health*. 2021;6(3):e164-e174. doi:10.1016/S2468-2667(20)30233-4

62. Papamihali K, Yoon M, Graham B, et al. Convenience and comfort: reasons reported for using drugs alone among clients of harm reduction sites in British Columbia, Canada. *Harm Reduct J*. 2020;17(1):90. doi:10.1186/s12954-020-00436-6

63. Weicker NP, Owczarzak J, Urquhart G, et al. Agency in the fentanyl era: Exploring the utility of fentanyl test strips in an opaque drug market. *Int J Drug Policy*. 2020;84:102900. doi:10.1016/j.drugpo.2020.102900

64. Kaplowitz E, Truong AQ, Macmadu A, et al. Fentanyl-related overdose during incarceration: a comprehensive review. *Health Justice*. 2021;9:13. doi:10.1186/s40352-021-00138-6

65. Attaway PR, Smiley-McDonald HM, Davidson PJ, Kral AH. Perceived occupational risk of fentanyl exposure among law enforcement. *Int J Drug Policy*. 2021;95:103303. doi:10.1016/j.drugpo.2021.103303

66. Netherland J, Hansen HB. The War on Drugs That Wasn't: Wasted Whiteness, "Dirty Doctors," and Race in Media Coverage of Prescription Opioid Misuse. *Cult Med Psychiatry*. 2016;40(4):664-686. doi:10.1007/s11013-016-9496-5

67. Schneider KE, Tomko C, Nestadt DF, Silberzahn BE, White RH, Sherman SG. Conceptualizing overdose trauma: The relationships between experiencing and witnessing overdoses with PTSD symptoms among street-recruited female sex workers in Baltimore, Maryland. *Int J Drug Policy*. 2021;92. doi:https://doi.org/10.1016/j.drugpo.2020.102859

68. Mennis J, Stahler GJ. Racial and Ethnic Disparities in Outpatient Substance Use Disorder Treatment Episode Completion for Different Substances. *J Subst Abuse Treat*. 2016;63:25-33. doi:10.1016/j.jsat.2015.12.007

69. Montgomery L, Burlew AK, Haeny AM, Jones CA. A Systematic Scoping Review of Research on Black Participants in the National Drug Abuse Treatment Clinical Trials Network. *Psychol Addict Behav J Soc Psychol Addict Behav*. 2020;34(1):117-127. doi:10.1037/adb0000483

70. Saloner B, Cook BL. Blacks And Hispanics Are Less Likely Than Whites To Complete Addiction Treatment, Largely Due To Socioeconomic Factors. *Health Aff Proj Hope*. 2013;32(1):135-145. doi:10.1377/hlthaff.2011.0983

71. Resiak D, Mpofu E, Rothwell R. Organic Collaborative Research Partnership Building: Researchers, Needle and Syringe Program Providers, and People Who Inject Drugs. *Healthcare*. 2021;9(11):1417. doi:10.3390/healthcare9111417

72. United Nations General Assembly. *The United Nations Standard Minimum Rules for the Treatment of Prisoners (The Mandela Rules)*. United Nations; 2015:38. http://www.refworld.org/ docid/56209cd14.html.

73. US Department of Justice, Civil Rights Division. *The Americans with Disabilities Act and the Opioid Crisis: Combating Discrimination Against People in Treatment or Recovery*. US Department of Justice; 2022. https://www.ada.gov/opioid_guidance.pdf

74. Binswanger IA, Nguyen AP, Morenoff JD, Xu S, Harding DJ. The association of criminal justice supervision setting with overdose mortality: a longitudinal cohort study. *Addict Abingdon Engl*. 2020;115(12):2329-2338. doi:10.1111/add.15077

75. Virani HN, Haines-Saah RJ. Drug Decriminalization: A Matter of Justice and Equity, Not Just Health. *Am J Prev Med*. 2020;58(1):161-164. doi:10.1016/j.amepre.2019.08.012

76. Wallace B, MacKinnon K, Strosher H, et al. Equity-oriented frameworks to inform responses to opioid overdoses: a scoping review. *JBI Evid Synth*. 2021;19(8):1760-1843. doi:10.11124/JBIES-20-00304

77. World Health Organzation, United Nations Office on Drugs and Crime. *Treatment and Care for People with Drug Use Disorders in Contact with the Criminal Justice System: Alternatives to Conviction or Punishment [Pre-Launch].*; 2018.

78. American Psychiatric Association. DSM-5 Criteria for Opioid Use Disorder. In: *Diagnostic and Statistical Manual of Mental Disorders*. 5.

79. Wagner KD, Liu L, Davidson PJ, Cuevas-Mota J, Armenta RF, Garfein RS. Association between non-fatal opioid overdose and encounters with healthcare and criminal justice systems: Identifying opportunities for intervention. *Drug Alcohol Depend*. 2015;153(215-220):6072-6078. doi:10.1016/j.drugalcdep.2015.05.026

80. Brinkley-Rubinstein L, Zaller N, Martino S, et al. Criminal justice continuum for opioid users at risk of overdose. *Addict Behav*. 2018;86(August 2017):104-110. doi:10.1016/j.addbeh.2018.02.024

81. Gossop M, Trakada K, Stewart D, Witton J. Reductions in criminal convictions after addiction treatment: 5-year follow-up. *Drug Alcohol Depend*. 2005;79(3):295-302. doi:10.1016/j.drugalcdep.2005.01.023

82. Green TC, Clarke J, Brinkley-Rubinstein L, et al. Postincarceration Fatal Overdoses After Implementing Medications for Addiction Treatment in a Statewide Correctional System. *JAMA Psychiatry*. 2018;75(4):405-407. doi:10.1001/jamapsychiatry.2017.4614

83. Bozinoff N, DeBeck K, Milloy MJ, et al. Utilization of opioid agonist therapy among incarcerated persons with opioid use disorder in Vancouver, Canada. *Drug Alcohol Depend*. 2018;193(March):42-47. doi:10.1016/j.drugalcdep.2018.09.003

84. Boddey JA, Hodder AN, Günther S, et al. The costs of crime during and after publicly-funded treatment for opioid use disorders: a population-level study for the state of California. *Addiction*. 2017;112(5):838-851. doi:10.1111/add.13729

85. Sharif B. The Substance Abuse and Crime Prevention Act: Challenges and Promises for Public Health. *Californian J Health Promot*. 2003;1(1):32-42. doi:10.32398/cjhp.v1i1.215

86. Anglin MD, Huang D, Hser YI, Evans E, Brown AH, Teruya C. Impact of California's Proposition 36 on the Drug Treatment System: Treatment Capacity and Displacement. *Am J Public Health*. 2006;97(1):104-109. doi:10.2105/ajph.2005.069336

87. Anglin MD, Nosyk B, Jaffe A, Urada D, Evans E. Offender diversion into substance use disorder treatment: The economic impact of california's proposition 36. *Am J Public Health*. 2013;103(6):1096-1102. doi:10.2105/AJPH.2012.301168

88. California Department of Corrections and Rehabilitation Statewide Mental Health Program. *Medication Assisted Treatment for Substance Use Disorders: 2nd Report to the Legislature*.; 2018.

89. Lofstrom M, Martin B, Raphael S. *Proposition 47's Impact on Racial Disparity in Criminal Justice Outcomes*. Public Policy Institute of California; 2020:22.

90. Health Management Associates. Expanding MAT in County Criminal Justice Settings. Published 2018. https://matincountycj.healthmanagement.com/

91. Fournier DA, Skaug HJ, Ancheta J, et al. AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. *Optim Methods Softw*. 2012;27:233-249.

92. Skaug H, Bolker B, Magnusson A, Nielsen A. Generalized Linear Mixed Models using "AD Model Builder." Published online January 19, 2016.

93. Stolwijk AM, Straatman H, Zielhuis GA. Studying seasonality by using sine and cosine functions in regression analysis. *J Epidemiol Community Health*. 1999;53(4):235-238.

94. Moore BJ, Barrett ML. *Case Study: Exploring How Opioid-Related Diagnosis Codes Translate From ICD-9-CM to ICD-10-CM*. U.S. Agency for Healthcare Research and Quality; 2017. Available: https://www.hcup-us.ahrq.gov/datainnovations/icd10_resources.jsp

95. Heslin KC, Owens PL, Karaca Z, Barrett ML, Moore BJ, Elixhauser A. Trends in Opioid-related Inpatient Stays Shifted After the US Transitioned to ICD-10-CM Diagnosis Coding in 2015. *Med Care*. 2017;55(11):918-923. doi:10.1097/MLR.0000000000000805

96. Yang H, Pasalic E, Rock P, Davis JW, Nechuta S, Zhang Y. Interrupted time series analysis to evaluate the performance of drug overdose morbidity indicators shows discontinuities across the ICD-9-CM to ICD-10-CM transition. *Inj Prev*. 2021;27(Suppl 1):i35-i41. doi:10.1136/injuryprev-2019-043522

97. De Crescenzo LA, Gabella BA, Johnson J. Interrupted time series design to evaluate ICD-9-CM to ICD-10-CM coding changes on trends in Colorado emergency department visits related to traumatic brain injury. *Inj Epidemiol*. 2021;8(1):15. doi:10.1186/s40621-021-00308-y

98. Ciccarone D. The rise of illicit fentanyls, stimulants and the fourth wave of the opioid overdose crisis. *Curr Opin Psychiatry*. 2021;34(4):344-350. doi:10.1097/YCO.0000000000000717

99. West KL, Lindquist K, Rodda LN. Fentanyl epidemic hits the U.S. West Coast: Opioid-related deaths in San Francisco from 2009-2019. *Int J Drug Policy*. 2021;95:103402. doi:10.1016/j.drugpo.2021.103402

100. Varshneya NB, Thakrar AP, Hobelmann JG, Dunn KE, Huhn AS. Evidence of Buprenorphine-precipitated Withdrawal in Persons Who Use Fentanyl. *J Addict Med*. Published online November 23, 2021. doi:10.1097/ADM.0000000000000922

101. Ahmed S, Bhivandkar S, Lonergan BB, Suzuki J. Microinduction of Buprenorphine/Naloxone: A Review of the Literature. *Am J Addict*. 2021;30(4):305-315. doi:10.1111/ajad.13135

102. Antoine D, Huhn AS, Strain EC, et al. Method for Successfully Inducting Individuals who use Illicit Fentanyl onto Buprenorphine/naloxone. *Am J Addict*. Published online June 23, 2020:10.1111/ajad.13069. doi:10.1111/ajad.13069

103. Rabinowitz M, Weisberg R, Pearce LM. *The California Criminal Justice Data Gap*. Stanford Law School, Stanford Criminal Justice Center; 2019:23.

104. Scott CK, Dennis ML, Grella CE, Mischel AF, Carnevale J. The impact of the opioid crisis on U.S. state prison systems. *Health Justice*. 2021;9(1):17. doi:10.1186/s40352-021-00143-9

105. Ferguson WJ, Johnston J, Clarke JG, et al. Advancing the implementation and sustainment of medication assisted treatment for opioid use disorders in prisons and jails. *Health Justice*. 2019;7(1):19. doi:10.1186/s40352-019-0100-2

106. Krawczyk N, Bandara S, Merritt S, et al. Jail-based treatment for opioid use disorder in the era of bail reform: a qualitative study of barriers and facilitators to implementation of a state-wide medication treatment initiative. *Addict Sci Clin Pract*. 2022;17:30. doi:10.1186/s13722-022-00313-6

Appendix A: Definition of Outcomes

Outcome	Data Source	Definition	Years available
All arrests	California Department of Justice, Criminal Offender Record Information data	Step type codes 1A, 1B, 1C	2005-2020
Drug-related arrests		Offense codes 35000-35999	
Drug-related misdemeanor arrests		Offense type M	
Drug-related felony arrests		Offense type F	
All convictions		Disposition codes 2500-2799	
Drug-related convictions		Offense codes 35000-35999	
Drug-related misdemeanor convictions		Offense type M or conviction stat codes 2-5 AND offense code 35000-35999	
Drug-related felony convictions		Offense type F or conviction stat code 1 AND offense code 35000-35999	
Property arrests		Step type codes 1A, 1B, or 1C AND offense codes between 22000-24999, 27000-27999, or 32000-32999	
Property convictions		Disposition codes 2500-2799 AND offense codes between 22000-24999, 27000-27999, or 32000-32999	
Violent arrests		Step type codes 1A, 1B, or 1C AND offense codes between 09000-13999, 20000-20999, or 36000-37999	
Violent convictions		Disposition codes 2500-2799 AND offense codes between 09000-13999, 20000-20999, or 36000-37999	
Drug overdose death	California Department of Public Health, Vital Statistics Data	Underlying cause of death codes: X40-X44, X60-X64, Y10-Y14, X85	2005-2020
Accidental drug overdose death		Underlying cause of death codes: X40-X44	
Intentional drug overdose death		Underlying cause of death: X60-X64	
Any opioid-related death	California Department of Public Health, Multiple Cause of Death files	Multiple cause of death codes of T40.0, T40.1, T40.2, T40.3, T40.4, or T40.6	2005-2018
Methadone-related death		Multiple cause of death code T40.3	
Heroin-related death		Multiple cause of death code of T40.1	
Natural & Semi-synthetic opioid-related death		Multiple cause of death code T40.2	
Primary diagnosis opioid overdose Emergency Department Visit or Hospitalization	California Department of Health Care Access and Information	Presence of at least one of the follow codes in the primary diagnosis or external cause fields for a visit: ICD-9 (prior to Oct 2015) – 965.00, 965.01, 965.02, 965.09, 970.1, E850.1, E850.2, E850.0; ICD-10 (Oct 2015 to date) – the following codes that also include a 6th digit 1-4 & 7th digit A or D:	2005-2020

		T40.1X, T40.0X, T40.2X, T40.3X, T40.4X, T40.60, T40.69	
Any diagnosis opioid overdose Emergency Department Visit or Hospitalization		Presence of at least one of the follow codes across all 20 diagnostic categories or external cause codes for a visit: ICD-9 (prior to Oct 2015) – 965.00, 965.01, 965.02, 965.09, 970.1, E850.1, E850.2, E850.0; ICD-10 (Oct 2015 to date) – the following codes that also include a 6th digit 1-4 & 7th digit A or D: T40.1X, T40.0X, T40.2X, T40.3X, T40.4X, T40.60, T40.69	
Primary opioid-related Emergency Department Visit or Hospitalization		Presence of any opioid overdose code above or the following codes below in the primary diagnosis or external cause fields: ICD-9 (prior to Oct 2015) - 304.00-304.02, 304.70-304.72, 305.50-305.52, E935.0, E935.1, E935.2, E940.1; ICD-10 (Oct 2015 to date) – F11 series, T40.0X5, T40.2X5, T40.3X5, T40.4X5, T40.605, T40.695	
Any diagnosis opioid-related Emergency Department Visit or Hospitalization		Presence of any opioid overdose code above or the following codes below in any of the 20 diagnosis or external cause fields: ICD-9 (prior to Oct 2015) - 304.00-304.02, 304.70-304.72, 305.50-305.52, E935.0, E935.1, E935.2, E940.1; ICD-10 (Oct 2015 to date) – F11 series, T40.0X5, T40.2X5, T40.3X5, T40.4X5, T40.605, T40.695	

Appendix B: Descriptive Statistics

Aim 2 Descriptive Statistics by County for Additional Outcomes

Figure 24. *Arrest Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020*

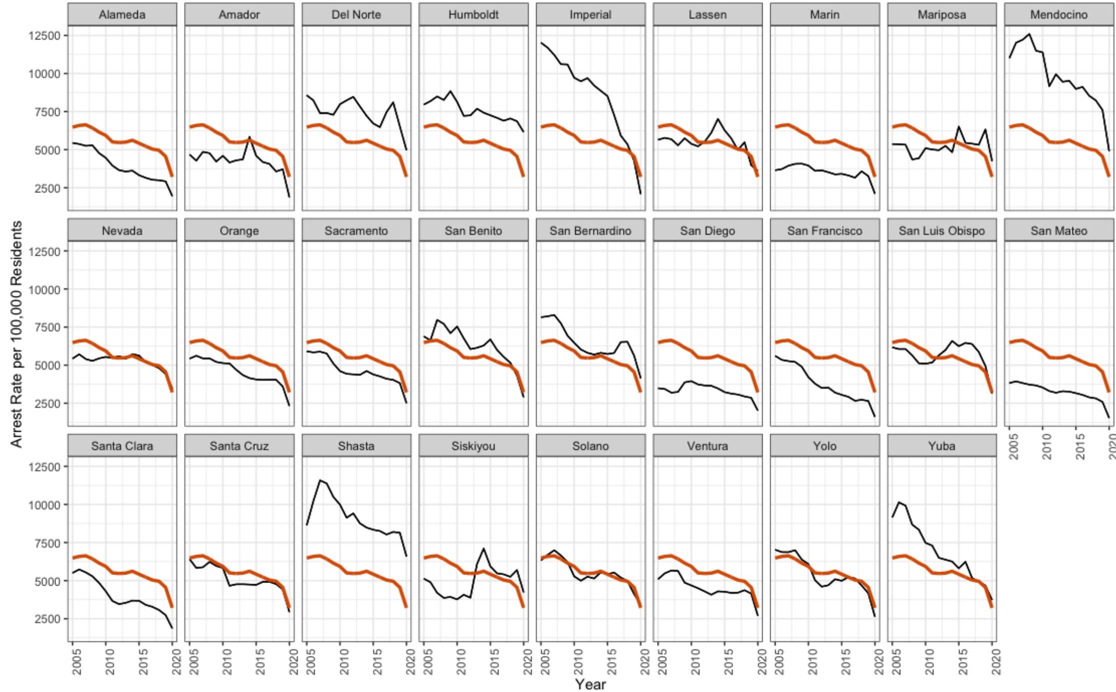


Figure 25. *Conviction Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020*

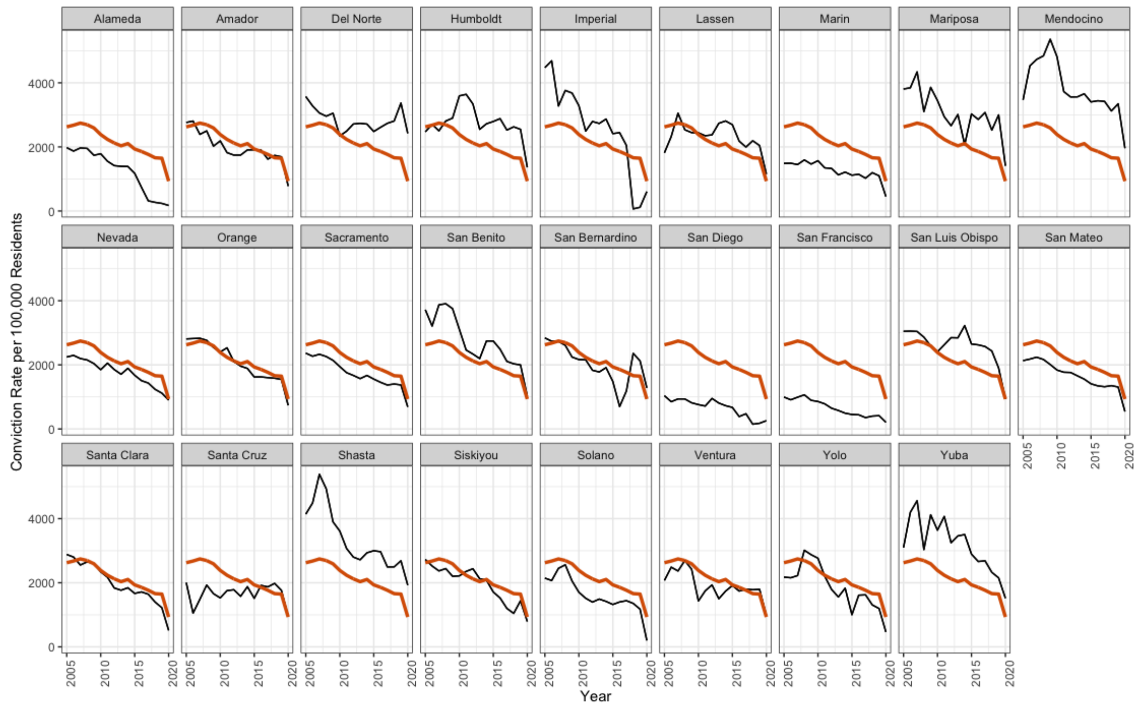


Figure 26. *Misdemeanor Drug Conviction Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs*

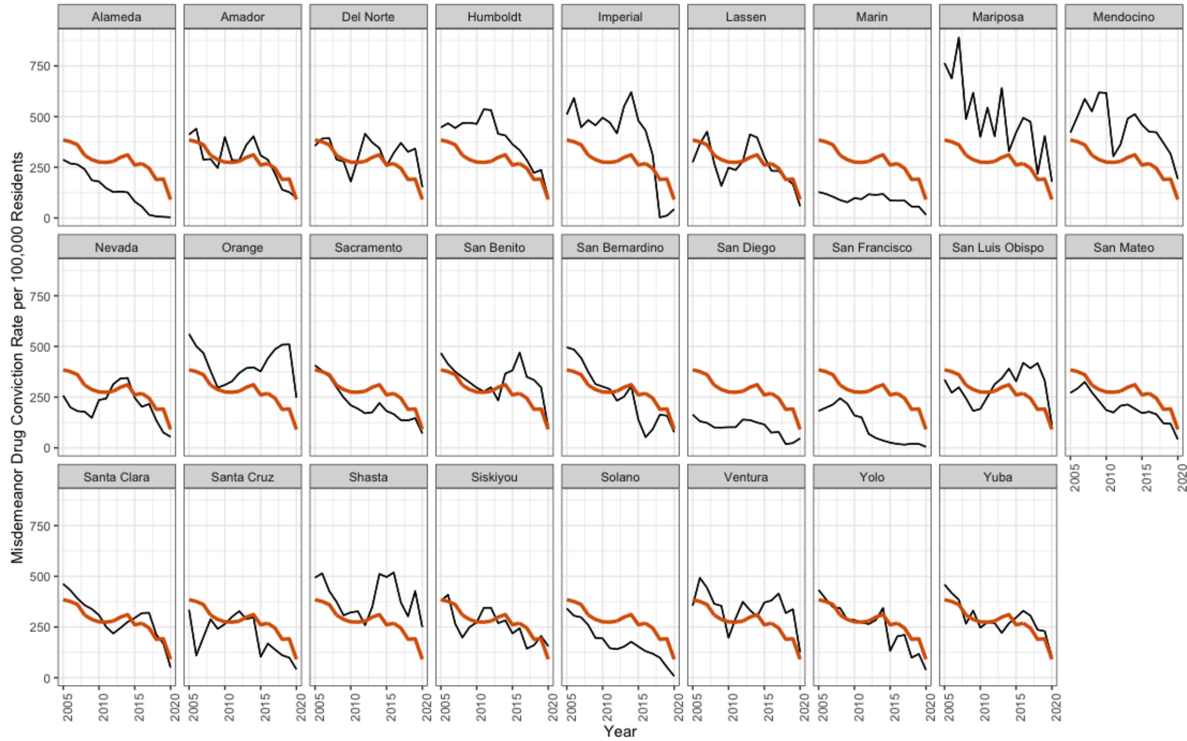


Figure 27. *Felony Drug Conviction Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs*

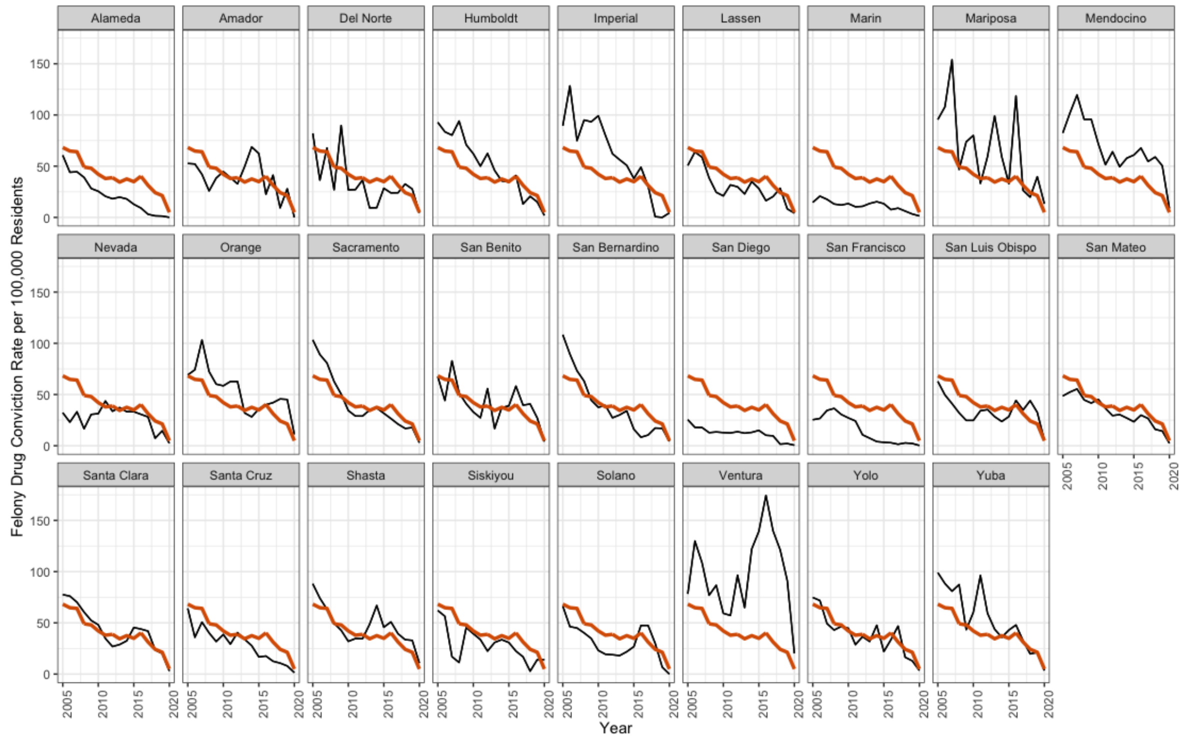


Figure 28. *Any Diagnosis Opioid-related Emergency Department (ED) Visit Rate per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020*

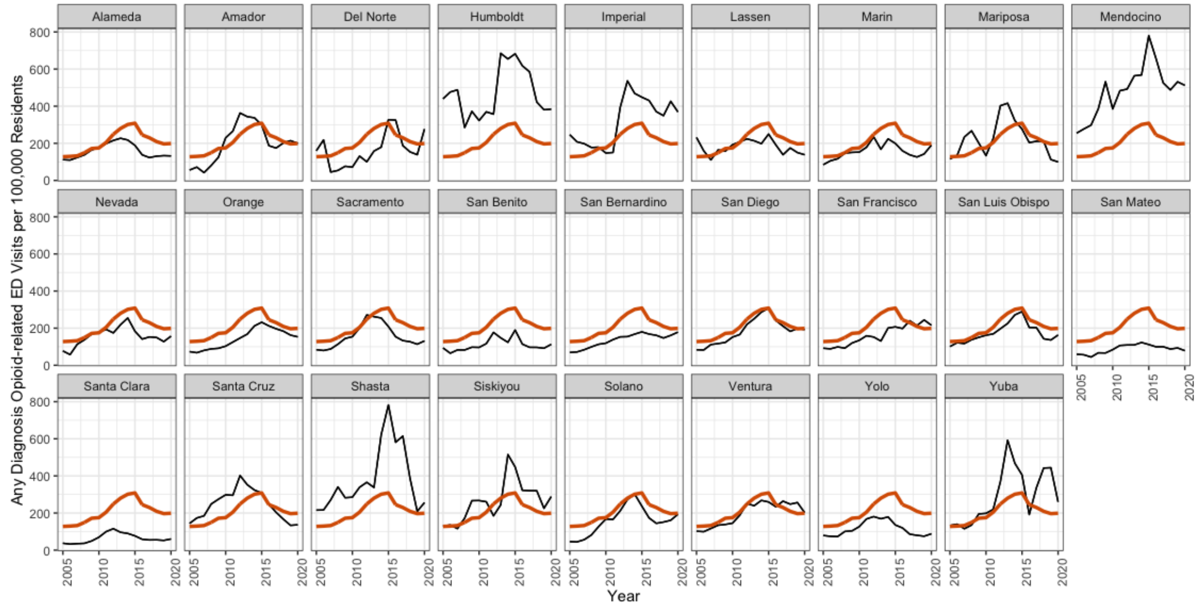


Figure 29. *Accidental Drug Overdose Death Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs*

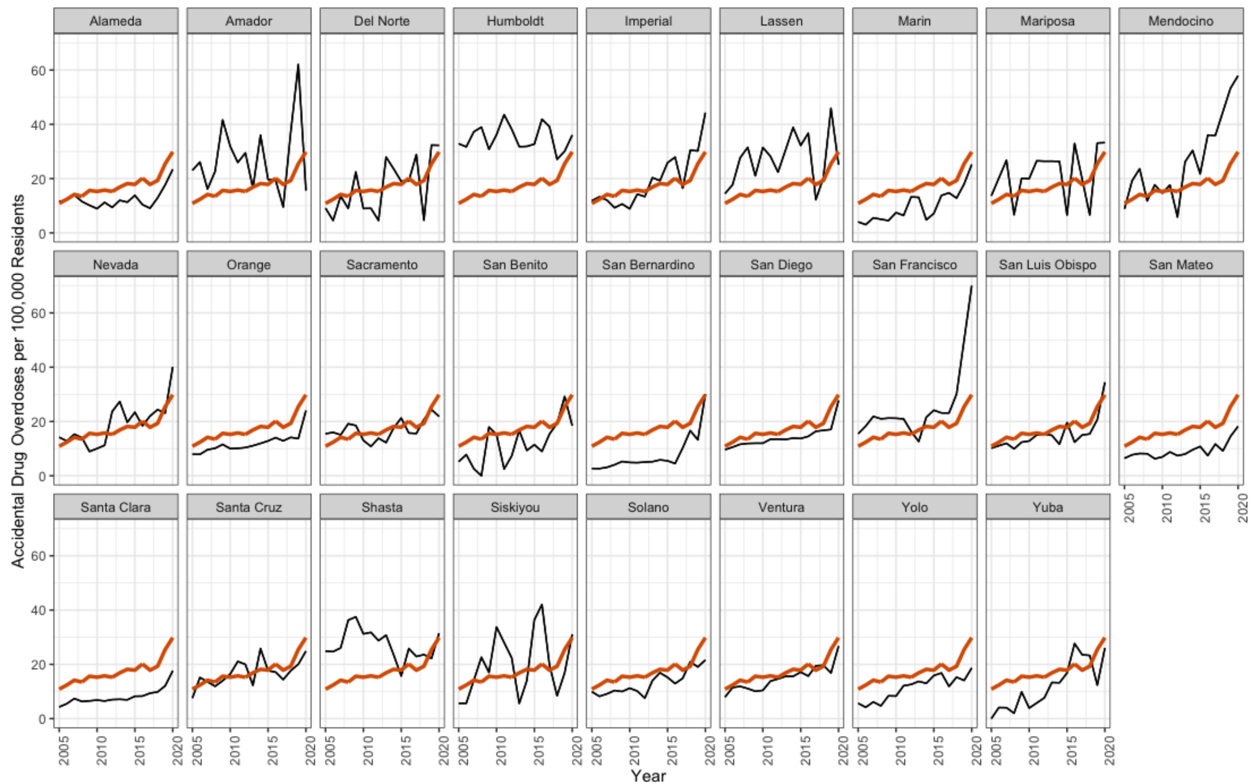
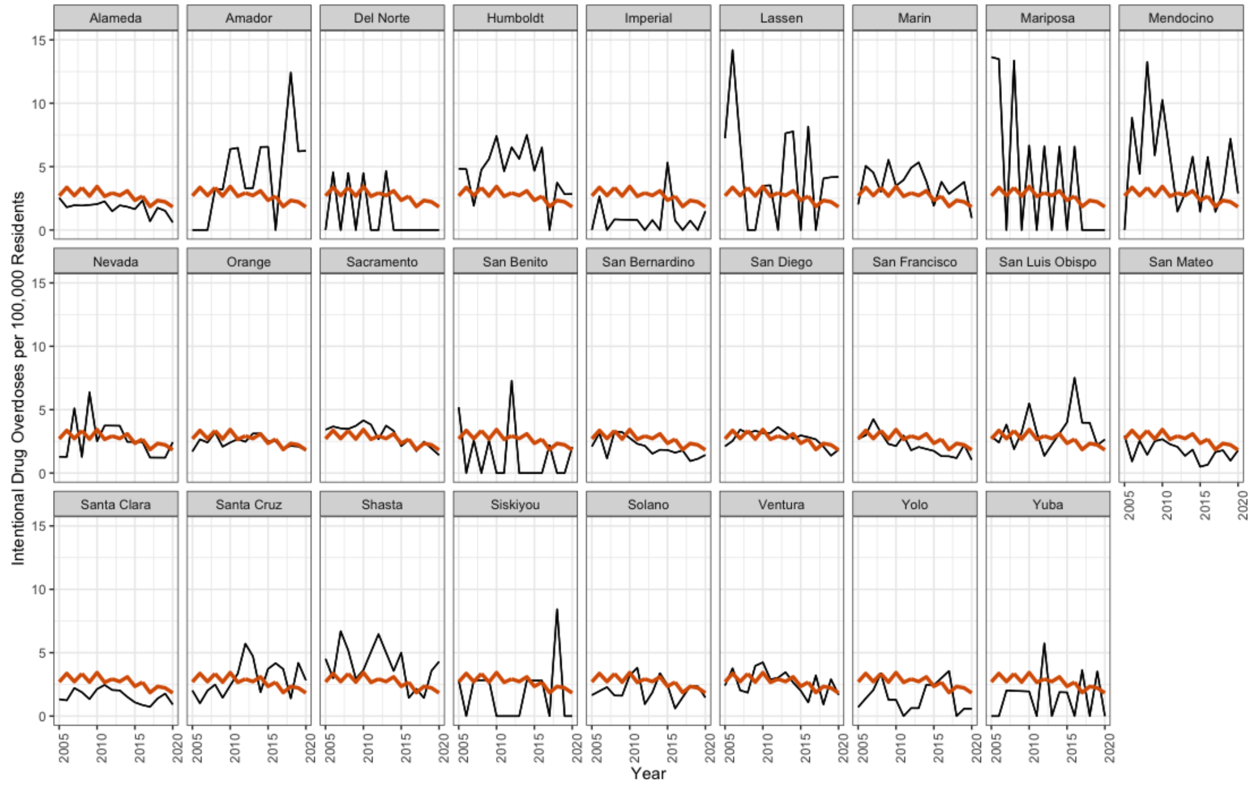


Figure 30. *Intentional Drug Overdose Death Rates per 100,000 Residents for 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs*



Aim 2 Descriptive Statistics of Outcome Categories for Comparison

Figure 31*. Arrest Outcomes Averaged over 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020*

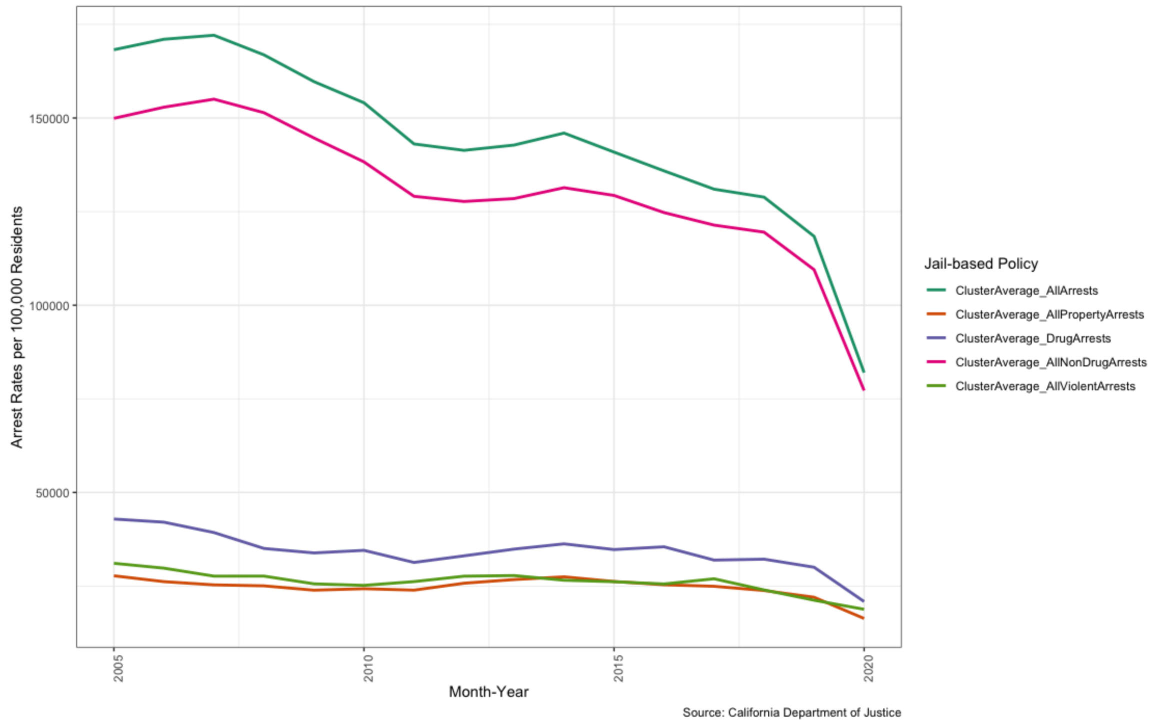


Figure 32. Conviction Outcomes Averaged over 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020

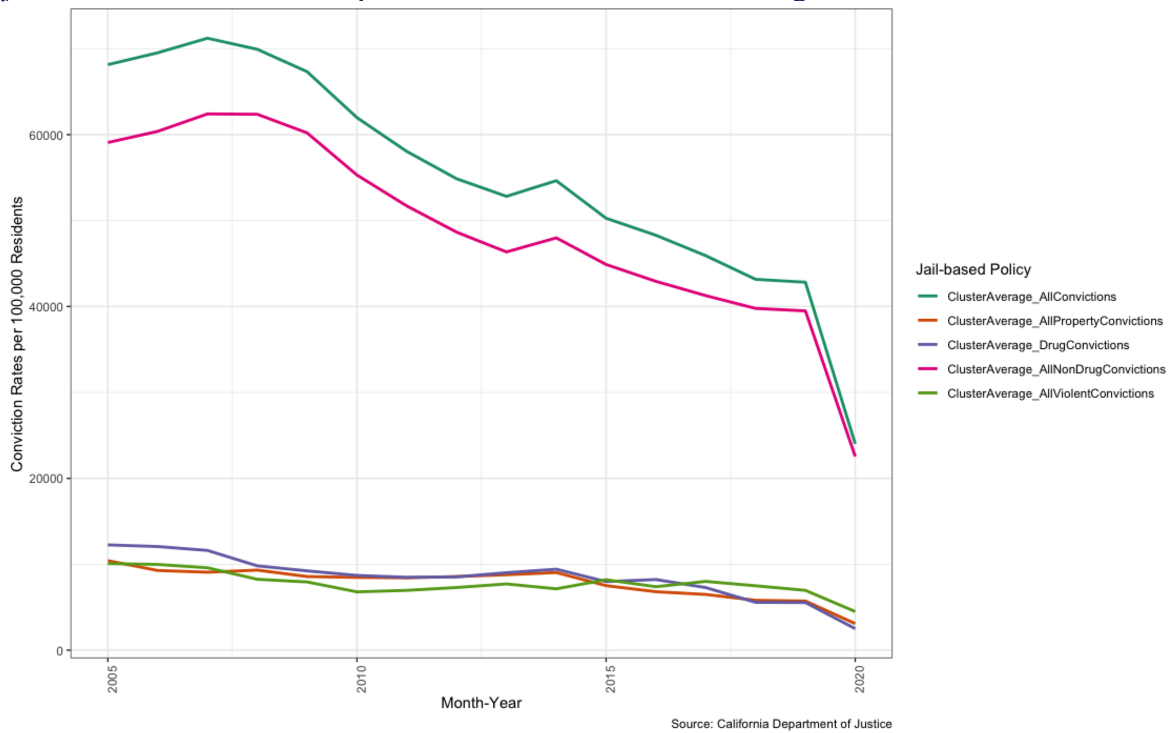


Figure 33. Emergency Department Outcomes Averaged over 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020

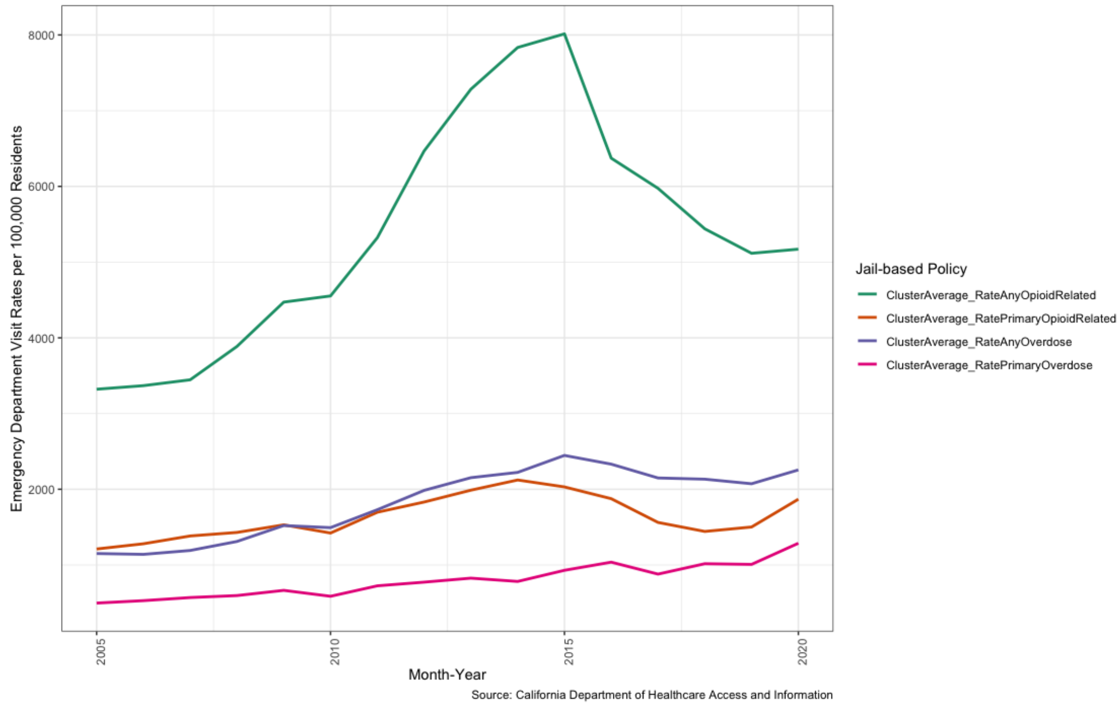


Figure 34. Hospitalization Outcomes Averaged over 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020

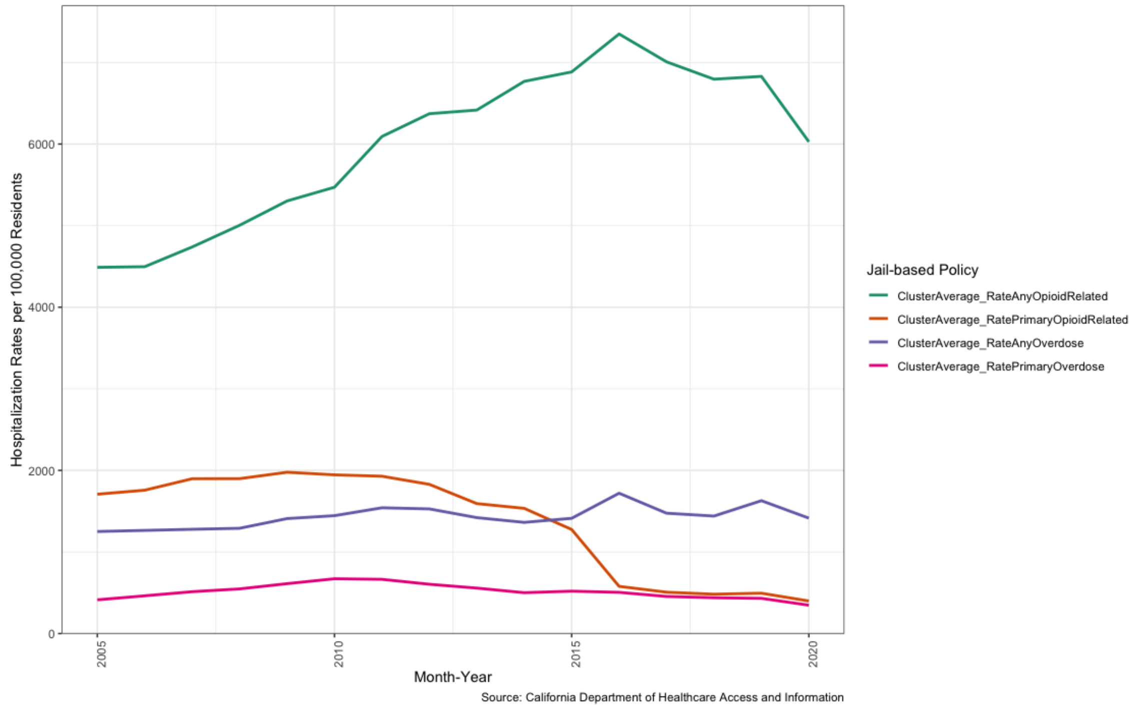


Figure 35. Drug Overdose Death Outcomes Averaged over 26 California Counties included in a study of jail-based Medication for Opioid Use Disorder Treatment Programs – 2005-2020