Saving Lives, Improving Livelihoods? The Case of Medication for Drug Dependence

Sarah Eichmeyer, Aljoscha Janssen, Jonathan Zhang*

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Abstract

We study the effects of buprenorphine medication on the lives—and survival—of veterans with opioid use disorder using over twenty years of administrative records. A staggered adoption difference-in-differences design exploits facility-time changes in the share of physicians who newly obtain X-waivers necessary to prescribe the drug to estimate patient-level impacts after opioid overdose events, while an emergency department physician buprenorphine prescribing propensity instrument isolates within facility-and-time variation in receipt of buprenorphine. A 5-percentage-point increase in the facility-level prescriber buprenorphine adoption rate doubles long-term buprenorphine use after overdose events, increases substance-use treatment engagement by 26%, lowers depression scores by 11%, reduces 2-year mortality by 4 points, and boosts vocational program enrollment by 65%. Physician prescribing propensity reduced form results replicate these patterns, and IV estimates confirm sizable treatment-on-the-treated benefits. These findings underscore the power of a targeted medical innovation to temper one of the most pressing public health crises of our time.

*Eichmeyer: Bocconi University. sarah.eichmeyer@unibocconi.it. Janssen: Singapore Management University. ajanssen@smu.edu.sg. Zhang: Duke University, VA Office of Mental Health, and NBER. jonathan.zhang@duke.edu. We thank seminar participants at the Triangle Applied Microeconomics Workshop for valuable feedback. The contents of this paper do not represent the views of the U.S. Department of Veterans Affairs or the United States Government.

1. Introduction

If people struggling with substance use disorder could access a treatment that substantially improved or effectively managed their condition, how much would their lives improve? Naively, one might assume this would lead to dramatic gains in health, economic stability, and social well-being. However, the answer is not immediately clear. Even if an effective medication existed, consistent adherence may be difficult, limiting the treatment's real-world impact. Moreover, improvements in addiction-related health outcomes may not automatically translate into broader gains: individuals might face underlying challenges, such as mental health problems, economic instability, or social marginalization, that independently drive poor outcomes across various domains of life. Understanding these issues is crucial from a policy perspective, as it informs whether resources should be prioritized toward expanding treatment itself, focused on improving adherence, or complemented with other interventions addressing these broader underlying factors.

Opioid Use Disorder (OUD) provides a particularly compelling context for empirical investigation of this question: clinical trials indicate that medication for opioid use disorder (MOUD), particularly buprenorphine, can dramatically reduce or even eliminate opioid dependence under tightly controlled conditions (Mattick et al., 2014). However, whether these promising results hold up outside of medical RCT settings, and whether they translate into improvements in broader economic, psycho-social, and health outcomes remains uncertain.

In this paper, we study the broad impacts of buprenorphine treatment administered in regular medical care on individuals with OUD. We leverage comprehensive electronic health records from the Veterans Health Administration (VHA) on over 8 million veterans, spanning more than two decades. The VHA's integrated system offers an exceptionally well-suited setting, capturing complete clinical and program histories for more than 175,000 veterans with OUD, with virtually no insurance-related attrition, in an environment of non-fragmented care specialized in substance-use and behavioral health. For identification, we first employ a dynamic difference-in-differences framework that exploits the staggered expansion, across facilities and over time, in the share of physicians who actively prescribe buprenorphine. Following its FDA approval for opioid use disorder treatment in 2002, adoption

has depended on physicians first obtaining an X-waiver (the federal authorization required to prescribe buprenorphine) and then initiating prescribing. This framework addresses the policy-oriented question of how increasing provider adoption affects patient outcomes. Second, we implement an instrumental variable strategy using within-facility-and-time variation in emergency department (ED) physicians' tendencies to administer buprenorphine to estimate the causal treatment effect of receiving buprenorphine on patient outcomes. Our outcomes of interest are comprehensive, encompassing healthcare utilization (overall outpatient, mental health, and substance use treatment visits), critical health events (overdose, ED visits, mortality, depression severity), and economic indicators (vocational training, disability benefit applications).

We find that when a facility's share of clinicians actively prescribing buprenorphine rises by five percentage points (pp), long-term buprenorphine uptake among patients affected by OUD doubles. This treatment surge is followed by a 3.7 pp drop in two-year mortality—nearly a 25% reduction from the very high 16% baseline—along with a 26% increase in monthly SUD treatment engagement, an 11% decline in PHQ-9 depression scores, and small but consistent increases in routine mental- and physical-health care, with no detectable spike in ED use or repeat overdoses. The gains extend beyond health: the same expansion drives a 65% relative jump in veterans' enrollment in VA vocational-rehabilitation programs, signaling meaningful economic re-engagement alongside the life-saving health benefits. In short, broader prescriber adoption not only expands medication use but also preserves lives and nudges patients toward better health management and early signs of economic re-engagement.

A completely orthogonal test confirms that these patterns are not artifacts of other facility-level shocks correlated with medical workforce buprenorphine adoption. Patients with opioid use disorder triaged to an ED clinician who initiates buprenorphine at a five pp higher rate—relative to other ED physicians in the same facility and quarter—experience qualitatively similar improvements in long-term treatment uptake, SUD engagement, health-care engagement, and survival, as well as reductions in reliance on VA disability benefits. This close qualitative match rules out confounding facility policies and underscores a robust, patient-level link between access to buprenorphine and life-course outcomes.

Instrumenting patient-level buprenorphine receipt with ED physician prescribing propen-

sity, we estimate that initiating buprenorphine at or shortly after the ED visit cuts two-year mortality risk by 13 pp, and leads to substantial decreases in filing of VA disability benefit claims.

Beyond these baseline effects, we examine mechanisms that clarify who benefits most, when the gains arise, and how they materialize. We find that buprenorphine is especially life-saving for patients in poor physical health, while those with serious mental illness show the largest increases in engagement with ongoing care, though with smaller mortality gains. Event-study analyses reveal that health improves almost immediately, whereas economic reintegration builds only gradually, suggesting that stability in health is a precondition for broader recovery. Facility-level buprenorphine adoption expansions increase overall MOUD treatment—rather than replacing methadone treatment (the other widely used medication-based treatment of OUD)—consistent with its greater scalability in office-based settings. Finally, a back-of-the-envelope cost–benefit analysis indicates that survival benefits alone outweigh additional medical costs of expansions of provider buprenorphine adoption within three years, reinforcing the view that expanding buprenorphine access is both life-saving and cost-effective.

In sum, effective medication for opioid use disorder does more than blunt withdrawal and craving: in regular clinical practice it substantially increases survival, meaningfully boosts engagement in medical care and nudges patients back toward the labor market, underscoring the promise of medical innovation to temper one of the defining public-health and economic challenges of our time.

This paper contributes to the literature on the causal impacts of treatment of substance abuse on life outcomes. The number of well-identified studies in this area remains surprisingly small.[1] Gui (2025) employs a difference-in-differences design, showing that states where the 2016 Comprehensive Addiction and Recovery Act newly granted independent prescribing authority to nurse practitioners saw large increases in buprenorphine dispensing and roughly

[1]In terms of correlational work, there are a large number of medical studies that show associations between buprenorphine and subsequent health outcomes, comparing those who receive MOUD to those who do not (e.g., Weiner et al., 2024; Larochelle et al., 2018). In terms of medical RCTs, tightly controlled, small-scale medical trials summarized by Mattick et al. (2014) reinforce the clinical efficacy of buprenorphine on short-term treatment retention and reductions in illicit opioid use but are under-powered to study serious adverse events, offer limited external validity for effects obtained in regular medical care, and do not study long-run economic outcomes.

a 20% decline in opioid-overdose mortality. Using repeated cross-sections among commercially insured patients, Barrette, Dafny and Shen (2023) exploit county-level changes in the share of X-waivered clinicians and find that greater prescriber capacity increases (decreases) the share in medication-assisted (residential) treatment, lowers drug-related ED visits, and reduces spending. SUD treatment facility openings and closings provide another source of variation: Swensen (2015), Bullinger, Wang and Feder (2023) and Corredor-Waldron and Currie (2022), and Bondurant, Lindo and Swensen (2018) find that an increase in the number of such facilities causes reductions in drug-induced mortality, ER visits for SUD issues, and local crime, respectively. Smaller-scale studies show that access to jail-based buprenorphine cuts recidivism without a detectable impact on mortality rates (Evans, Wilson and Friedmann, 2022) and that overdose patients serviced by a buprenorphine-equipped ambulance increase their subsequent engagement with OUD treatment without a detectable impact on subsequent overdose events (Carroll et al., 2023). Kim (2023) compares the changes in outcomes of adolescents entering residential SUD treatment to those of matched controls and finds favorable effects on education and labor market outcomes. Beyond the opioid crisis, Williams and Bretteville-Jensen (2024) shows that longer wait times for cannabis-use treatment increase healthcare utilization, crime, and reduce employment, while Costantini (2025) finds that longer waits for mental health treatment raise mortality.

Our study builds on this work in three ways. First, we combine two quasi-experimental designs—a facility-level staggered rollout and an ED-physician instrument—applied to rich individual-level panel data on a diverse veteran population, delivering tighter causal inference than prior studies that rely on repeated cross-sections, aggregate county- or state-level outcomes, and coarse policy variation. Second, we trace outcomes well beyond clinical retention or mortality to include healthcare utilization, vocational-training participation, and disability-benefit claims, thereby integrating economic and psycho-social dimensions largely absent from earlier research. Third, by focusing on variation in buprenorphine prescribing both at the workforce level and at the point of care, we separately identify the policy effect of expanding prescriber capacity and the treatment-on-the-treated effect of receipt itself—offering a unified framework that the existing literature lacks.

We also contribute to a broader literature quantifying the economic value of medical

innovation. Foundational work shows that welfare gains from new treatments often far exceed their costs (Murphy and Topel, 2006; Cutler and McClellan, 2001). More recent studies link specific technologies to labor-market outcomes: the withdrawal of Vioxx (a nonsteroidal anti-inflammatory drug) led to sizable earnings and employment losses (Garthwaite, 2012); direct-to-consumer advertising of SSRIs increased adherence and reduced absenteeism (Shapiro, 2022); and access to modern radiotherapy improved long-term employment for breast cancer patients (Daysal et al., 2024). By documenting both health and economic impacts of buprenorphine, our study extends this literature to medication for opioid use disorder—a setting where the social returns to innovation are widely assumed to be large but remain so far unquantified.

Lastly, we contribute to the growing economics literature on the opioid crisis (see Maclean et al., 2023, for a review). One strand of this work investigates the origins of the epidemic, tracing it to the diffusion of high-potency prescription opioids and variation in prescriber behavior during the late 1990s and early 2000s (e.g., Alpert et al., 2022; Schnell, 2025; Finkelstein, Gentzkow and Li, 2024; Eichmeyer and Zhang, 2022, 2023; Janssen and Zhang, 2023). Another strand evaluates the effects of supply-side interventions, often finding mixed efficacy and unintended consequences (e.g., Evans, Lieber and Power, 2019; Buchmueller and Carey, 2018; Soliman, 2025). A smaller but growing body of work examines the broader consequences of the opioid crisis, including effects on labor market outcomes and intergenerational well-being (Laird and Nielsen, 2016; Currie, Jin and Schnell, 2019; Ahammer and Halla, 2021). Our study contributes to this literature by quantifying the economic and health benefits of MOUD, highlighting the critical role of evidence-based medical treatment in addressing the ongoing opioid crisis.

The remainder of the paper proceeds as follows. Section 2 provides background on buprenorphine and its regulatory context. Section 3 describes the data, sample, and outcomes we use. Section 4 outlines our two complementary empirical strategies. Section 5 presents the main results and robustness checks. Section 6 explores extensions and mechanisms, including heterogeneity, dynamics, substitution from methadone, and cost–benefit analysis. Finally, Section 7 concludes.

2. Background: Buprenorphine

Buprenorphine is a semi-synthetic opioid first approved by the U.S. FDA in 2002 for the maintenance treatment of opioid use disorder (OUD). A single daily dose suppresses withdrawal and blocks the reinforcing effects of subsequent opioid use (Volkow and Blanco, 2020). This attribute led the World Health Organization and the U.S. Substance Abuse and Mental Health Services Administration to place buprenorphine at the center of their MOUD guidelines (World Health Organization (2009); SAMHSA, 2001).

Unlike methadone—the other widely used medication for treatment of OUD—buprenorphine can be prescribed in office-based settings and dispensed in take-home supplies. This feature spares patients the daily supervised dosing required at federally regulated methadone clinics, reduces bottlenecks in treatment capacity and allows the medication to reach many more patients at scale (Volkow and Blanco, 2020; Blanco and Volkow, 2019). Yet uptake remains well below clinical need, with only about 20% of the estimated more than two million U.S.-based patients with OUD receiving any treatment for their disorder, and of those, only a third receiving medication-based treatment (Williams et al., 2018).

Prescribing buprenorphine Until January 2023, clinicians in the United States were required to obtain a federal "X-waiver" under the Drug Addiction Treatment Act of 2000 (DATA 2000) in order to prescribe buprenorphine outside of SAMHSA certified and accredited opioid treatment programs. Obtaining the waiver entailed completion of eight hours of training for physicians (24 hours for nurse practitioners and physician assistants, beginning in 2016) and carried patient panel size caps that were gradually expanded over time (SAMHSA, 2001).[2]

Alongside this waiver regime, federal regulation also provided a more limited pathway for unwaivered clinicians, commonly known as the "3-day rule". This provision allowed any DEA-registered practitioner to *administer* (but not prescribe) one day's worth of a narcotic

[2]Recent studies of the 2023 removal of the X-waiver find little effect on buprenorphine prescribing (e.g., Christine et al., 2024; Chua et al., 2024). Our estimates may appear in tension with this evidence. However, our design captures the effect of actual adoption of buprenorphine prescribing by clinicians in a setting where patients present to EDs with opioid overdose—a crucial moment for initiating buprenorphine. By contrast, the waiver removal eliminated a broad regulatory barrier in a context where many clinicians already chose not to prescribe, and where other frictions (e.g., stigma, institutional support) limited uptake.

drug such as buprenorphine to a patient experiencing acute withdrawal, and to repeat this once daily for up to 72 hours (U.S. Drug Enforcement Administration, 2020). The intent was to offer short-term stabilization while arranging referral to formal treatment. Although the rule applies in any clinical setting, it has been especially relevant in emergency departments, where patients in withdrawal frequently present.

These institutional rules map directly onto our two empirical strategies. In the facility adoption difference-in-differences design, our treatment variable captures the share of non-ED clinicians who have both obtained an X-waiver and initiated prescribing, since only such clinicians could provide sustained outpatient buprenorphine treatment. We explicitly exclude ED providers from this measure, as their ability to administer buprenorphine under the 3-day rule does not require a waiver and does not reflect longer-term prescribing capacity. In contrast, our ED-provider–propensity design exploits precisely this emergency exception: because any DEA-registered ED providers can initiate buprenorphine for patients in withdrawal, variation in clinicians' historical tendency to do so provides a quasi-random instrument for receipt of the medication at the ED visit.

3. Data

We analyze data between 2003 and 2025 from the Veterans Health Administration (VHA), which provides healthcare to more than 9 million eligible veterans.[3] The VHA is the largest integrated healthcare system in the United States, providing care through a network of 170 medical centers and over 1,300 affiliated outpatient facilities across the country. Because VHA eligibility is stable and coverage is not tied to employment, we observe comprehensive clinical and program histories for our population of interest—more than 175,000 veterans with opioid use disorder—an unusually large and policy-relevant population with virtually no insurance-related attrition.

Our data cover every healthcare encounter delivered within the VA system, including outpatient visits, inpatient admissions, pharmacy dispensing records, and more. The VA was

[3]Eligibility includes prior active-duty service, discharge under conditions other than dishonorable, and either income-based qualification or a service-connected disability.

an early adopter of electronic health records, which enables access to detailed, structured data on diagnosis and procedure codes, provider and facility identifiers, patient demographics, and time-stamped clinical events. We additionally observe rich clinical metrics that are rarely available in claims data, such as structured mental health assessments (e.g., PHQ-9 depression scores). Beyond medical care, the data link to VA-administered social programs, including vocational rehabilitation, employment assistance, and disability compensation, allowing us to track economic and psychosocial outcomes within the same administrative universe.

To capture care veterans receive outside the VA system, we also link to Medicare Parts A, B, and D claims (2014–2019), Medicaid claims (2014–2015), and VA-reimbursed community-care records. The latter includes all emergency services delivered at non-VA facilities, which is particularly important for opioid-related health crises. Finally, we observe complete mortality data from the CDC National Death Index Plus, including date and cause of death, ensuring that long-run health outcomes are measured without loss to follow-up.

3.1 Sample

In our primary empirical research design, which exploits facility and time variation in provider buprenorphine adoption rates, we include all VA patients who experience a VA ED visit for an opioid overdose in the years 2004-2022. We restrict the sample to the patient's first qualifying ED opioid overdose event. The rationale for selecting overdose events is twofold. First, overdoses serve as a highly objective indicator of severe opioid use disorder, increasing the likelihood these individuals are clinically appropriate candidates for initiating buprenorphine treatment. Second, by relying on overdose rather than a previous diagnosis of OUD, we avoid endogenous selection biases related to variation across facilities and time in OUD diagnosis practices. Although one might worry that facility-time variation in buprenorphine adoption could itself influence which patients present with an opioid overdose, a covariate-balance test in Figure A.3 shows no systematic differences in pre-overdose characteristics, alleviating this concern.

Our second empirical strategy, which relies on within-ED across-provider variation in buprenorphine initiation propensity, includes the sample of all VA patients who visit the ED between 2004-2022 and have received an OUD diagnosis in the year prior to that ED

visit. As before, we only include each patient's first ED event satisfying these conditions. In contrast to the first sample, here we explicitly condition on a prior OUD diagnosis rather than requiring an overdose event. The rationale is that the instrumental variable approach leverages within-facility, across-ED-physician variation in prescribing behavior, eliminating the concerns regarding endogenous facility-level variation in diagnosis practices. Conditioning on prior OUD diagnosis instead of overdose events substantially increases the sample size and thus enhances the statistical power necessary for the IV analysis.

In both samples, we drop terminal cancer and end-of-life geriatric patients, as well as patients who die within seven days of the ED encounter. Our resulting samples consist of 7,517 unique patients for the facility buprenorphine adoption strategy and 142,931 unique patients for the ED provider instrumental variable strategy. We report summary statistics for each sample in Table 1.

3.2 Buprenorphine Treatment

We measure whether a patient is receiving buprenorphine for OUD via both prescription and administration of buprenorphine.[4] We construct monthly indicators for whether the patient fills any buprenorphine prescription or is administered buprenorphine for OUD. For our provider propensity design, we also construct a three-day (72 hour) indicator for buprenorphine initiation (via administration or prescription) from the time of the ED visit.

3.3 Outcomes

We measure outcomes within two years—excluding the first seven days—following the index ED visit across three domains: medical utilization, health and mortality, and economic engagement.

Utilization Outcomes. We measure outpatient healthcare utilization across four settings: (i) overall outpatient care; (ii) substance use disorder treatment; (iii) mental health care; and

[4]Specifically, we include sublingual and extended-release injection routes and exclude buccal and patch, which are typically used to treat pain and not OUD.

(iv) physical health care. Each utilization outcome is coded as a monthly indicator equal to one if a patient has at least one relevant encounter during that month.

Health Outcomes. Our health outcomes include both acute events and intermediate or long-run measures of well-being. Acute events are captured by (i) ED visits and (ii) opioid overdose events, as measured by ED visits and hospital admissions with opioid overdose diagnosis codes. These outcomes are coded as monthly indicators. For a subset of patients, we also observe mental health through the Patient Health Questionnaire–9 (PHQ-9) depression score, a validated scale from 0 to 27, available from structured VA mental health assessments. This outcome is coded at the month-level, using the average PHQ-9 score. Mortality is measured as the cumulative probability of death within 24 months of the index event. Together, these outcomes provide a direct assessment of patient morbidity, relapse, and survival, complementing the service use measures above.

Economic Outcomes. We track two economic indicators observed in VA administrative records. The first is enrollment in VA vocational rehabilitation and employment programs, which offer paid job training, counseling, and placement support for veterans with service-connected disabilities or other barriers to work. This outcome reflects active labor-market re-engagement facilitated through VA services. The second is the filing of a VA disability compensation claim, potentially capturing worsening disability status and a reliance on VA benefits. Both are coded as monthly indicators and provide insight into whether clinical improvements from buprenorphine treatment translate into economic participation or changes in benefit reliance.

Outcome Alignment Across Empirical Research Designs For the X-waiver adoption design, which lends itself to event study analysis, we construct monthly measures of all non-mortality outcomes from 12 months before to 24 months after the index overdose event. To summarize treatment effects, we report a post-versus-pre difference-in-differences estimate averaged over the post-treatment period—constructing the average only over those months in which the patient is alive. Similarly, for the ED physician buprenorphine prescribing propensity design, outcomes are constructed as the average of monthly outcomes over the 24

months following the index ED visit. Because the X-waiver design is not a balanced panel and is restricted to patient-months in which the patient is alive, we analogously average outcomes in the physician design only over months in which the patient remains alive. As a result, both the difference-in-differences and IV estimates can be interpreted as changes in average monthly outcomes over a 24-month post-ED period.

4. Empirical Strategy

Our empirical analysis leverages two complementary strategies, each addressing distinct but interrelated aspects of buprenorphine treatment provision. The first strategy, employing a dynamic difference-in-differences design, uses facility-level variation over time in physician adoption of buprenorphine prescribing to estimate the broader policy impact of expanding provider adoption on patient outcomes. The second strategy uses an instrumental variable approach exploiting within-facility variation in ED providers' tendencies to initiate buprenorphine, allowing us to isolate the causal effect of receiving buprenorphine. Together, these two strategies provide robust and complementary evidence on both the policy-driven expansion and the direct patient-level effects of buprenorphine treatment in real-world clinical settings.

4.1 X-Waiver Adoption Across Facility-Time

This empirical strategy leverages variation across facilities and over time in the adoption of buprenorphine for treating patients at an opioid crisis moment.

We measure adoption of buprenorphine as the share of providers in a facility-quarter who have both obtained an X-waiver and initiated prescribing buprenorphine. Specifically, we define $XWaiver_Frac_{s(i),t_0(i)}$ as the weighted fraction of non-ED providers who treat substance use disorder patients in facility $s(i)$ and quarter (of first opioid overdose) $t_0(i)$ that have prescribed or administered buprenorphine at least once previously. The fraction is weighted by the total number of substance use disorder patients that provider saw that calendar quarter.[5] We use this prescribing history as a proxy capturing both waiver status

[5]All providers in a facility-quarter that treat at least 10 substance use disorder patients are included, regardless of specialty. ED providers are dropped since they can emergency administer buprenorphine without an X-waiver.

and prescribing initiation, since obtaining the waiver alone does not always immediately translate into prescribing (Huhn and Dunn, 2017).

Figure 1 plots our measure of provider adoption over time (fraction of providers actively prescribing buprenorphine) alongside the fraction of OUD patients receiving buprenorphine. The figure illustrates two important points. First, there is a strong correlation between the fraction of prescribing providers and patient treatment rates, suggesting a robust first-stage relationship. Second, while the aggregate trends in provider prescribing and patient uptake appear smoothly increasing over the 20-year period, this masks substantial heterogeneity across individual facilities. Figure A.1 demonstrates that facilities often experience discrete jumps in provider adoption, with considerable heterogeneity in both timing and intensity. This staggered adoption pattern strengthens the plausibility and credibility of our empirical strategy.

With our measure of facility-by-time varying adoption of buprenorphine in hand, we estimate the following event-study specification:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{k=-12,\ k\neq -1}^{24} \beta_k \left(XWaiver_Frac_{s(i),t_0(i)} \times D_{it}^k \right) + \varepsilon_{it}, \tag{1}$$

where Y_{it} is outcome Y of patient i in relative event month t, and where D_{it}^k denotes relative event time dummies—relative to the patient's first opioid overdose ED event. We anchor the panel on the overdose event because it is an objective clinical "crisis moment" at which treatment for OUD is often first offered; aligning everyone on this event lets us follow comparable patients exactly when they become candidates for treatment.

We also estimate an aggregate difference-in-differences specification where we replace the event time dummies with a single $Post_{it}$ indicator variable. This allows us to report a simple aggregate estimate of the causal effect of buprenorphine adoption on outcomes in the two-years following the ED visit, relative to the one year before.[6]

Coefficients and standard errors are scaled by 0.05 (5 pp), which is roughly equivalent to the average increase in $XWaiver_Frac_{s(i),t_0(i)}$ between 2004 and 2022 (0.048), and the

[6]For the outcome of mortality, since it is an absorbing state and only occurs in the post-period, we cannot estimate a pre-post DiD specification. Instead, we regress a binary indicator for two-year mortality on $XWaiver_Frac_{s(i),t_0(i)}$, including facility and OD quarter (equivalent to calendar quarter at two-years) fixed effects.

p90-p10 difference in the treatment variable across facilities in 2018 (0.050). Heteroskedastic robust standard errors are clustered at the facility-(overdose) quarter level.

Identification Assumptions Our facility-by-time adoption design identifies causal effects under the standard difference-in-differences assumption of parallel trends: absent changes in buprenorphine prescribing capacity, outcomes for patients treated in high- and low-adoption facilities would have evolved similarly. Two key threats could violate this assumption. First, patient populations or patient health may change in ways correlated with facility adoption—for example, if facilities expand buprenorphine prescribing in response to sicker patients. Second, buprenorphine adoption may coincide with other policy or facility-level changes—such as state opioid initiatives, Medicaid expansions, or shifts in local practice—that independently affect outcomes.

We probe these concerns in several ways, detailed in the robustness section. In brief: to address the possibility of patient composition or patient health changes driving the buprenorphine adoption rate among a facility's providers, we show in event-study plots that outcomes are flat in the pre-period, and we regress patients' pre-overdose demographic and clinical covariates on facility adoption rates; both checks show no evidence of differential selection. To address contemporaneous state-level policy shocks, we further saturate our baseline specification with state-by-calendar-quarter fixed effects, absorbing variation from state-level reforms that may coincide with adoption.

One could still worry that there are facility-level changes closely correlated in time with buprenorphine adoption changes (such that they would not show up in differential pre-trends) that independently influence outcomes—for example, other changes to SUD treatment programs or shifts in facility resources. To convincingly rule this out, we would need to exploit variation in exposure to buprenorphine across patients that occurs *within*-facility-and-time. This is precisely what we do with our second empirical strategy, laid out in the next section, which leverages the quasi-random assignment of patients to ED physicians with different propensities to prescribe buprenorphine.

4.2 ED Provider Propensity Within Facility-Time

We complement our across-facility-time research design on buprenorphine adoption with a within-facilit-time approach that leverages the quasi-random assignment of patients with OUD to ED providers.

Under a special exemption from the DEA, clinicians are permitted to administer buprenorphine for up to 72 hours in emergency situations without holding an X-waiver. This exception is intended to prevent severe withdrawal symptoms, stabilize patients, and bridge them to longer-term treatment. Importantly, a first dose in the ED rarely ends at 72 hours: observational studies show that patients started on buprenorphine during an ED visit are far more likely to fill subsequent prescriptions and to remain in treatment, largely because ED clinicians schedule follow-up buprenorphine treatment with outpatient care (Jennings et al., 2021; Herring et al., 2024). Thus, the initial ED buprenorphine often sets patients on the path to sustained treatment with the drug—making clinician-level variation in this decision a powerful probe of buprenorphine's downstream effects.

Motivated by the important role ED providers play in initiating MOUD treatment—and by evidence that clinicians vary in their willingness to do so (Lanham et al., 2022)—we estimate each ED provider's propensity to administer or prescribe buprenorphine in emergency settings. We pair this with the quasi-random assignment of OUD patients to providers within EDs to implement a "judges' design," which identifies the causal effect of receiving buprenorphine while holding constant all facility-time-level factors. In contrast to our facility adoption design, which exploits across-facility-time variation in MOUD adoption, this within-facility design leverages variation in provider behavior, holding fixed facility-time factors.

We detail the construction of patient i's ED provider j's buprenorphine prescribing propensity, labeled $\tilde{Z}_{ij}$, in Appendix B. Intuitively, $\tilde{Z}_{ij}$ reflects the provider's average propensity to administer buprenorphine in emergency settings, net of variation due to time, facility, shift structure, and diagnosis. This "residualized prescription rate" allows us to isolate variation in provider behavior that is plausibly exogenous to patient case mix, enabling causal estimation under a judges'-design framework. We then first estimate the reduced form

impact of provider buprenorphine propensity on patient outcomes using Equation (2):

$$Y_i = \beta^{RF} \tilde{Z}_{ij} + \alpha_{st} + \lambda_{swd} + \gamma_{diagnosis} + \eta_i, \tag{2}$$

where α_{st} denotes facility-by-quarter fixed effects; λ_{swd} denotes fixed effects for facility-by-weekend-status-by-time-of-day[7]; and $\gamma_{diagnosis}$ captures 3-digit ICD-9 diagnosis fixed effects.

We scale β^{RF} by 0.05 (5pp)—approximately the 90th-10th percentile difference between ED providers in the same facility-year.

Finally, we estimate the causal impact of receiving buprenorphine within 72 hours using the familiar 2SLS instrumental variable approach:

$$Y_i = \beta^{IV} Bup_i + \alpha_{st} + \lambda_{swd} + \gamma_{diagnosis} + \varepsilon_i, \tag{3}$$

$$Bup_i = \pi \tilde{Z}_{ij} + \alpha_{st} + \lambda_{swd} + \gamma_{diagnosis} + u_i, \tag{4}$$

where Bup_i is an indicator for whether patient i received buprenorphine within 72 hours of their ED visit, and where Equation (4) is the first-stage equation. In Equation (3), we instrument Bup_i with $\tilde{Z}_{ij}$.[8]

Identification Assumptions The primary identification assumption is that patients are quasi-randomly assigned to providers within EDs, conditional on facility-by-quarter, facility-by-weekend-by-time-of-day, and broad diagnosis. This conditional independence assumption enables a causal interpretation of the reduced-form estimate in Equation (2) as the effect of being treated by a provider with a higher propensity to administer buprenorphine. We provide empirical support for this assumption in panel (b) of Figure 3, where we show that high- and low-propensity providers treat observably similar patients, as measured by predicted buprenorphine receipt and predicted mortality. In addition, Figure A.4 demonstrates that patients assigned to providers of differing propensities are also similar in terms of a wide set of baseline covariates used to construct those predictions.

[7]Time of day controls are meant to approximate ED physician shifts (7am–3pm, 3pm–11pm, 11pm–7am) and helps capture variation in provider assignment.

[8]In both the reduced form and the IV, heteroskedasticity-robust standard errors are clustered at the facility-quarter level.

For our instrumental variable approach, which aims to recover the causal impact of receiving buprenorphine, we further require the relevance, exclusion restriction and monotonicity assumptions. We show relevance (i.e., a strong first stage) in the results section. The exclusion restriction requires that an ED physician's prescribing propensity affect downstream outcomes only through its impact on whether the patient receives buprenorphine in the ED. This assumption is plausible in the emergency-care setting because physicians have no continuing relationship with the patient and few levers—other than the initial prescription and referral—to influence medium-term health or economic trajectories.

5. Results

5.1 Effects of Facility-Level Buprenorphine Adoption Expansion

Our first set of results examines how expanding provider adoption of buprenorphine treatment at VA facilities shapes patients' trajectories following an opioid overdose. It is not clear whether making an effective addiction medication more widely available would translate into broader improvements in individuals' lives——especially beyond narrowly defined health outcomes. Our findings suggest reason for cautious optimism.

We begin by examining how increased provider prescribing capacity translates into patient-level buprenorphine use. Figure 2 presents an event-study plot of monthly buprenorphine use relative to the date of a patient's index overdose, for a 5 pp increase in the fraction of providers prescribing buprenorphine at a given facility. The figure shows no evidence of differential pre-trends, followed by a sharp 10 pp increase in the month immediately following the overdose, and a sustained effect of approximately 4 pp over the subsequent 24 months. Averaging over this post-period, we estimate a 4.7 pp increase in buprenorphine use per month—about a 100% increase relative to the pre-overdose mean—documented in Table 2. This result confirms that expansions in provider buprenorphine adoption indeed translate into meaningful increases in uptake and adherence among patients following an opioid crisis.

Increased treatment availability is accompanied by modest yet promising shifts in broader healthcare utilization patterns (panel a of Table 3). Outpatient visits rise by 2.2 pp per

month from a baseline of 76 percent, driven by a notable 4.1 pp (over 25% relative increase) rise in engagement with substance use disorder treatment services. Mental and physical health visits also see small but consistent upticks, suggesting that initiating buprenorphine treatment may lead individuals to engage more actively with healthcare, which could reflect improved self-care or stability.

Critically, greater provider adoption of buprenorphine is lifesaving: mortality within two years of the index overdose falls by 3.7 pp—about a 23% decline relative to the 16% baseline risk (column 4, panel B of Table 3). Beyond survival, we observe meaningful gains in mental health: the average PHQ-9 depression score drops by 1.3 points (from a baseline of 11.7 points, where 10–14 denotes moderate depression), underscoring tangible psychological benefits for patients (column 3).[9] We detect no statistically significant effect on overdose events, a pattern that may reflect limited power given the very low baseline overdose rate of 1%.

Importantly, we see evidence that expanding access to buprenorphine can positively affect patients' economic trajectories (panel c). Enrollment in VA vocational rehabilitation and employment programs rises by 1.3 pp—an increase of approximately 65% relative to the low baseline enrollment rate of 2%. We detect no meaningful impacts on applications for VA disability compensation.

Taken together, these results suggest that broadening provider adoption of buprenorphine prescribing does not solely increase treatment uptake; the expansion delivers a substantial reduction in mortality, improves mental health, and boosts engagement with substance-use and routine medical care. It also catalyzes economic re-engagement. These results strengthen the argument that addressing addiction through expanded medication availability yields benefits well beyond narrow clinical targets, though it remains clear that treatment alone may not address all underlying socioeconomic factors driving poor outcomes.

Robustness We perform three standard robustness exercises and one "cross-design" check to probe the robustness of the results presented above; together they leave our baseline

[9]The effects on depression are identified off only 5,155 patient-month, thus should be interpreted with caution. A 5% increase in provider adoption increases the likelihood of having a PHQ-9 taken by a statistically insignificant 0.003 (SE=0.002).

estimates intact and confirm that our results are not driven by omitted policy shocks or functional-form assumptions.

First, saturating the specification with state-by-calendar-quarter fixed effects—thereby absorbing any contemporaneous state opioid initiatives, Medicaid expansions, or opioid-related policies—barely moves the point estimates. The results are presented in column 2 of Table A.1.

Second, replacing the continuous prescribing share with a binary indicator that switches on when a facility's buprenorphine-prescribing rate among diagnosed OUD patients first exceeds 5% (and remains above 5% for four consecutive quarters)[10] delivers estimates that are statistically indistinguishable from our baseline elasticities, reinforcing that our findings are not an artifact of an ill-fitting linearity assumption in the treatment variable. The results are presented in column 4 of Table A.1

Third, we test for differential patient selection into our baseline sample of first overdose ED visits by regressing pre-overdose demographic and clinical covariates on the facility-level adoption rate, controlling for facility and time fixed effects (i.e., using the same cross-sectional specification as for our mortality outcome). As reported in Figure A.3, only four of the 50 covariates exhibit a statistically significant association at the 10% level—a rate lower than that expected by pure chance at this level of significance—confirming balance on observables across high- and low-adoption facility-time-periods.

As an additional validation we exploit the completely orthogonal source of variation embodied in our second design. Specifically, we estimate the reduced-form relationship between outcomes and the ED physician's historical propensity to prescribe buprenorphine. Because this propensity measure varies *within* facility–time and is unrelated to facility-level practice patterns, it offers a powerful falsification test: if our X-waiver results were driven by unobserved facility shocks, the physician-level reduced form results should look very different. Instead, the estimates in Table 4 and Table A.2 mirror the X-waiver effects qualitatively (while magnitudes are difficult to compare across the two sources of variation)—larger physician buprenorphine prescribing propensity raises the probability of post-ED-visit buprenorphine

[10]Based on visual inspection, this 5% threshold was chosen to coincide with when facilities generally first experience a discontinuous increase in X-waivered clinicians. For instance, in Figure A.2, this threshold picks up rapid expansions reasonably well.

use, increases mental and physical healthcare utilization, decreases mortality, and decreases filing of VA disability benefit claims. The tight qualitative alignment across two independent sources of identification reinforces the credibility of our main findings while setting the stage for the IV estimates that isolate the treatment-on-the-treated effect in the next section.

5.2 Treatment-on-Treated Effects of Buprenorphine Receipt

Our second empirical strategy moves from the policy margin of prescriber availability to the individual margin of treatment receipt. By instrumenting a patient's buprenorphine initiation with the initiation propensity of the ED provider who happened to treat the patient, we recover treatment-on-the-treated (TOT) effects that are free of facility-level confounders and speak directly to the causal impact of receiving medication.

First stage. Table 4 reports a strong first stage: a 5 pp increase in an ED provider's buprenorphine prescribing propensity—roughly the 90th–10th percentile gap within a facility-year—raises the probability that the patient receives buprenorphine in the ED by 4.8 pp, a 87% jump over the 5.5% mean. The induced treatment persists, generating 1.4–2.2 pp higher buprenorphine use in each of the following 24 months (ca. 20% increase relative to the mean), consistent with high-buprenorphine-propensity ED providers further referring patients to long-term care for their OUD with buprenorphine. The Kleibergen–Paap F-statistic exceeds 125 for our preferred 3-day window (column 1), and comfortably exceeds 10 for each subsequent time period within our 2-year post-ED-visit window.[11]

IV results: ED initiation. Instrumenting receipt at the ED visit yields patterns, shown in Table 5, that are broadly aligned with the facility-level findings. Buprenorphine initiation triggers large and statistically significant increases in subsequent mental- and physical-health visits, suggesting that medication facilitates broader self-care. In terms of health-outcome, we see an imprecise 5.6 pp reduction in all-cause ED visits and a sizeable and significant 13 pp decline in two-year mortality—roughly 3.5 times the intent-to-treat effect implied by the facility design. Economic responses are in line with those documented in the other

[11] Panel (a) of Figure 3 shows that the relationship between provider buprenorphine prescribing tendency and receipt of buprenorphine is monotonically increasing along the entire distribution of prescribing tendency.

empirical strategy: while vocational-rehabilitation take-up rises slightly and insignificantly, VA disability receipt falls by a statistically significant 1.7 pp, consistent with better health translating to lower reliance on disability benefits.

IV results: six-month exposure. The effects of buprenorphine are likely to be much larger among patients who successfully adhere to treatment over time. Because adherence is never perfect, the 3-day IV estimates reported above can be interpreted as a lower bound on the treatment effect of continuous buprenorphine use. To provide suggestive evidence on this more intensive margin, we instrument for six-month adherence (defined as $\geq$ 6 months of buprenorphine use within the first year) using the same ED physician–prescribing-propensity measure. The logic is that high-propensity ED physicians not only administer buprenorphine acutely but also connect patients to ongoing outpatient care with buprenorphine (Jennings et al., 2021; Herring et al., 2024), making their initial prescribing propensity a valid predictor of sustained adherence.

As expected, the first stage is weaker when we move from initiation to six-month adherence, with the effect of a 5 pp increase in physician prescribing propensity raising six-month adherence by about 2.2 pp rather than the 4.8 pp seen for immediate initiation (see column 3 vs. column 1 of Table 4). Because the reduced-form relationships remain unchanged, the IV estimates scale up accordingly: the 6-month IV treatment effects are roughly twice as large as those from the initiation design. In practice, this implies an almost 30 pp reduction in two-year mortality, very large increases in outpatient and substance-use treatment engagement, and more pronounced declines in VA disability receipt, underscoring the effectiveness of buprenorphine adherence for sustained health and economic recovery (see Table A.3).

Overall, the physician buprenorphine prescribing propensity design corroborates our facility-level results through an entirely separate source of quasi-random variation and confirms that the life-saving and engagement effects we document are driven by buprenorphine itself rather than by contemporaneous changes in facility policy or patient mix.

6. Extensions and Mechanisms

The baseline estimates establish that greater buprenorphine capacity saves lives and sets veterans on a path toward better mental health and modest economic re-engagement. To understand *for whom* these gains arise, *when* they unfold, *how* they arise, and whether they are *worth the money*, we conduct four additional analyses that speak directly to the questions raised in the introduction.

Heterogeneity. It is not obvious that effective medications for OUD will translate into broad and sustained life improvements for everyone. Even if adherence is achieved, health gains may not automatically spill over into economic or psycho-social domains, especially for patients burdened by severe co-morbidities or serious mental illness. To probe these possibilities, we examine whether the effects of buprenorphine access differ systematically across patient subgroups defined by their prior health status and treatment history.

We consider three natural margins of heterogeneity, each intended to capture a distinct dimension of baseline patient risk. First, we split patients by whether their number of Elixhauser comorbidities in the year before the overdose is above or below the median, using this as a summary measure of their overall physical health. Second, we separate patients by the presence or absence of a serious mental illness diagnosis (such as schizophrenia, bipolar disorder, or major depressive disorder) in the prior year, to test whether psychiatric comorbidity conditions the ability of patients to benefit. Third, we distinguish between patients who did or did not receive buprenorphine treatment in the year prior to their overdose, using this as a proxy for OUD severity and prior engagement with treatment. For each subgroup, we re-estimate our facility-level adoption design, and present the results in Figure A.5.

The patterns are informative. Patients with higher Elixhauser scores—those in worse physical health—experience much larger survival gains from buprenorphine access, suggesting that treatment is especially life-saving for the sickest. However, these same patients show little improvement in vocational rehabilitation participation compared with their healthier counterparts, indicating that frailty may limit the ability to translate survival into economic

recovery. This divergence highlights the possibility that buprenorphine's most important margin for high-comorbidity patients is mortality reduction rather than socio-economic reintegration.

Turning to mental health, patients with a serious mental illness diagnosis benefit disproportionately from greater engagement with medical care once buprenorphine is available: outpatient visits, and both mental and physical health encounters rise more sharply in this group. At the same time, their survival improvement is smaller relative to patients without a serious mental illness. This pattern is consistent with buprenorphine acting as a gateway to care for the psychiatrically ill, but with lingering challenges that blunt the mortality effect, echoing the introductory concern that broader underlying factors can independently shape outcomes.

Finally, prior buprenorphine users—patients who had already initiated treatment at some point prior to their overdose—respond strongly across every margin. They show higher gains in outpatient engagement, more pronounced survival benefits, and a larger boost in vocational rehabilitation enrollment, despite a smaller increase in buprenorphine uptake itself (since many were already on the medication). This suggests that when patients are already partially connected to treatment, shocks that expand buprenorphine access reinforce adherence and produce compounding benefits across both health and economic domains.

Taken together, the heterogeneity results underscore that buprenorphine's benefits are not evenly distributed. They are most life-saving for those in poor physical health, most engagement-enhancing for those with serious mental illness, and most broadly transformative for those who had prior exposure to treatment. These findings speak directly to the motivating question of whether and for whom medical innovation translates into real-world improvements, suggesting that treatment both rescues the sickest from premature death and, when layered onto prior treatment engagement, can enable a broader cascade of health and economic gains.

Dynamics. Studying the dynamics of treatment effects allows us to learn about the *sequence* in which health and economic gains emerge. This matters for understanding mechanisms: if health outcomes improve first and economic outcomes follow with a lag, this would suggest that sustained medical stabilization is a prerequisite for broader life recovery.

Figure A.6 traces treatment effects of a 5pp increase in a facility's buprenorphine adoption rate on monthly outcomes for twenty-four months following the index overdose. Two distinct phases emerge.

Health metrics react almost instantaneously: in the first three post-treatment months we observe sizable declines in ED visits and PHQ-9 depression scores, as well as increases in outpatient visits (driven by physical health visits). These gains remain essentially constant and statistically robust through month 24, indicating a sustained rather than transitory effect. By contrast, vocational-rehabilitation engagement steadily increases in the first 6 months, stabilizing thereafter at an average 2pp increase over baseline. Mortality follows a similar gradual dynamic.

The staggered timing—immediate, persistent health improvements followed by a delayed but durable rise in workforce-re-integration—supports a constraint-release narrative in which buprenorphine first stabilizes patients medically and psychologically, thereby enabling subsequent economic recovery.

Substitution from other MOUD. Buprenorphine and methadone are the two most widely used evidence-based, first-line treatments for opioid use disorder. It is therefore natural to ask whether expanding access to one therapy simply displaces patients from the other; answering this question clarifies whether the benefits we estimate reflect a reallocation of existing patients across medications or extensive margin responses of engaging new patients in MOUD treatment. To do so, we re-estimate our baseline facility-adoption empirical design for the outcome of a patient receiving methadone treatment in a given month.

Table A.4 shows coefficients that are small and statistically indistinguishable from zero at every time horizon within the two-year window. The improvements we document therefore arise from drawing new patients onto evidence-based medication rather than reshuffling existing ones across therapies. This is an important distinction for policy makers deciding whether to prioritize encouragement of substitution from methadone to buprenorphine among existing patients vs. expansion of treatment capacity overall. Our results highlight the value of the latter, and they are consistent with a key institutional difference between the two medications: although both methadone and buprenorphine have been shown to be

effective in reducing illicit opioid use in randomized trials (Mattick et al., 2014), methadone delivery is constrained by its restriction to specialized opioid treatment programs, whereas buprenorphine can be prescribed in routine outpatient settings and is therefore far more scalable. It is thus natural that we observe an expansion of overall treatment rather than cannibalization of methadone patients.

Cost–benefit calculation. Beyond documenting health and economic impacts, an important policy question is whether expanding buprenorphine access represents good value for money. Policymakers often face tradeoffs across competing interventions, and a cost–benefit lens helps benchmark the returns to expanding access against conventional thresholds used in health economics.

Table C.1 converts our estimated treatment effects into dollars, comparing the per-patient costs (additional outpatient and inpatient costs) of expanding a facility's rate of provider buprenorphine adoption by 5pp with per-patient monetized survival benefits.[12]

On the cost side, healthcare spending, relative to the counterfactual of no rise in provider buprenorphine adoption, increases by ca. \$7,500 (\$700) per patient in year 1 (year 2), and falls by ca. \$1,000 in year 3. In comparison, the cumulative costs of buprenorphine are negligible, reaching \$515 by year 3.

On the benefit side, applying a conventional value of a statistical life year (VSLY) of \$300,000, the observed 0.035 life years saved by year 3 translates into roughly \$10,410 in VSLY gains.

Adding up cumulative costs and benefits, we find that the latter (\$10,410) exceeds the former (\$8,087) by year 3, yielding a net benefit of ca. \$2,300 per patient. Because this back-of-the-envelope calculation ignores broader social gains, such as from the documented reduced reliance on disability benefits and higher re-engagement in the labor market, the estimate is likely to be an lower bound.

Thus, even under these deliberately conservative assumptions, expanding buprenorphine access passes a textbook cost-effectiveness test within 3 years of the expansion. This finding reinforces the view that targeted medical innovation can generate life-saving and economically

[12] "Per patient" here means per patient who presents with an overdose in the ED. See Appendix C for details.

efficient returns in the face of the opioid crisis.

7. Conclusion

This paper asked whether expanding access to a proven medical treatment for drug addiction can meaningfully improve both health and broader life outcomes in real-world practice. In the case of the opioid crisis, we provide evidence from the Veterans Health Administration showing that it does. Expanding buprenorphine prescribing capacity increases treatment uptake, reduces mortality, improves mental health, and fosters modest economic re-engagement. These benefits arise because more patients are brought into treatment, not because existing patients are shifted across therapies, and they are large enough that survival gains alone outweigh additional medical spending within a few years.

Thus, a medication's promise shown in randomized trials to effectively treat a substance use disorder can translate into meaningful real-world gains, even amid imperfect adherence and substantial patient heterogeneity. Buprenorphine stabilizes patients medically and psychologically, and this stability enables downstream improvements in economic outcomes. The results suggest that removing delivery frictions around proven medications can generate substantial returns far beyond the clinical domain.

For policy, the message is clear: lowering barriers to prescribing and sustaining buprenorphine—through training, reimbursement, and integration into routine care—is a cost-effective way to save lives and strengthen recovery. More generally, the findings highlight the value of policies that pair medical innovation with effective delivery systems, turning clinical efficacy into social impact in the face of one of today's most pressing public-health crises.

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Tables

Table 1: Summary Statistics

	Sample:	
	X-Waiver	ED Propensity
	(1)	(2)
Female	0.11	0.08
Race: Black	0.22	0.23
Race: Other	0.03	0.02
Race: White	0.69	0.70
Ethnicity: Hispanic	0.06	0.06
Age	53.88	50.90
Age: 18-34	0.17	0.17
Age: 35-49	0.17	0.23
Age: 50-64	0.39	0.45
Age: 65+	0.26	0.15
Number of Elixhauser Comorbidities in Prior Year	3.37	2.84
Number of Patients	7,517	142,931

Notes: This table presents summary statistics for our two samples corresponding to our two empirical strategies. Column 1 corresponds to the x-waiver design which focuses on all patients first opioid overdose in VA emergency departments between 2004 and 2022. Column 2 corresponds to the ED physician propensity design which focuses on first ED visits among prior OUD patients between 2004 and 2022. Age is measured at the time of the index event and number of prior comorbidities is measured in the prior 365 days.

Table 2: Buprenorphine Adoption Design: Buprenorphine Treatment

	All estimates are scaled by ×0.05 *Dependent variable*: Buprenorphine Treatment (×0.05)				
		Event Month:			
	2-Year DiD	1-6	7-12	13-18	19-24
	(1)	(2)	(3)	(4)	(5)
$XWaiver_Frac$	0.047***	0.056***	0.031***	0.020***	0.016
	(0.008)	(0.008)	(0.009)	(0.010)	(0.011)
Mean Dep. Var. (Prior Month)	0.050	0.050	0.050	0.050	0.050
Observations (Patient-Month)	252,838	252,838	252,838	252,838	252,838

Notes: This table presents the first stage impact of $XWaiver_Frac$ on buprenorphine treatment. Column 1 presents the average treatment effect over 24 months (aggregate version of Equation (1) where event time indicators are replaced with a single post overdose indicator). Columns 2 to 5 presents the average event study coefficients over six month horizons. For instance, column 2 presents the average of event study coefficients in post-period months 1 to 6 and its associated standard error. An observation is a patient-month. Coefficients and standard errors are scaled by 0.05—-approximately the average increase in the treatment variable (the fraction of providers with an X-waiver) between 2004 and 2022, and also the 90th–10th percentile difference in the treatment variable across facilities in 2018. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

Table 3: Buprenorphine Adoption Design: Difference-in-Differences Outcomes (2 Year)

All estimates are scaled by $\times 0.05$

Panel (a): Utilization

	Outpatient	SUD Treatment	Mental Health	Physical Health
	(1)	(2)	(3)	(4)
$XWaiver_Frac \times Post$	0.022^{***}	0.041^{***}	0.023^{***}	0.026^{***}
	(0.008)	(0.008)	(0.007)	(0.008)
Mean Dep. Var. (Prior Month)	0.76	0.16	0.31	0.7
Observations (Patient-Month)	252,838	252,838	252,838	252,838

Panel (b): Health Outcomes

	ED Visit	Opioid Overdose	Depression Score	Mortality, 2Y
	(1)	(2)	(3)	(4)
$XWaiver_Frac \times Post$	0.0002	0.002	-1.315^{*}	
	(0.005)	(0.001)	(0.691)	
$XWaiver_Frac$				-0.037^{*}
				(0.022)
Mean Dep. Var. (Prior Month)	0.26	0.01	11.72	
Mean Dep. Var. (Month 24)				0.16
Observations (Patient-Month)	252,838	252,838	5,155	7,517

Panel (c): Economic Outcomes

	Vocational Rehabilitation & Employment	VA Disability Claim
	(1)	(2)
$XWaiver_Frac \times Post$	0.013^{***}	0.003
	(0.004)	(0.002)
Mean Dep. Var. (Prior Month)	0.02	0.021
Observations (Patient-Month)	252,838	182,850

Notes: This table presents the impact of $XWaiver_Frac$ on utilization (panel a), health (panel b), and economic (panel c) outcomes. The aggregate difference-in-differences estimate over 24 months are displayed. The exception is 2-year cumulative mortality which is estimated in a single cross-sectional regression. Utilization outcomes, ED visits, opioid overdose, and economic outcomes are all indicator variables. Depression score is the PHQ-9 score (max of 27) and conditional on having PHQ-9. All outcomes exclude the first 7 days immediately following the ED visit. Data on VA Disability is only available from 2004 to 2021, and thus estimated on patients overdosing between 2005 and 2019. Coefficients and standard errors are scaled by 0.05—-approximately the average increase in the treatment variable (the fraction of providers with an X-waiver) between 2004 and 2022, and also the 90th-10th percentile difference in the treatment variable across facilities in 2018. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

Table 4: Physician Propensity Design: Buprenorphine Treatment

	All estimates are scaled by $\times 0.05$ *Dependent variable*: Buprenorphine Treatment					
			Event Month:			
	3 Day	2-Year	1-6	7-12	13-18	19-24
	(1)	(2)	(3)	(4)	(5)	(6)
Provider Propensity	0.048***	0.016***	0.022***	0.014***	0.014***	0.015***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Mean Dep. Var.	0.055	0.082	0.092	0.081	0.078	0.076
Observations (Patients)	142,880	142,880	142,880	142,880	142,880	142,880

Notes: This table presents the impacts of provider propensity to emergency administer buprenorphine, Z_{ij}, on buprenorphine utilization over different time periods. Column 1 is the first stage regression with buprenorphine within 72 hours. The F-statistic on the first stage is 125.3. Column 2 is the 2-year average, computed as the average over 24 indicators for any buprenorphine use each month. Columns 3 to 6 is the average of any buprenorphine over 6 month periods. Months where the patient has died are coded as missing and are thus not averaged over. Coefficients and standard errors are scaled by 0.05–approximately the 90th–10th percentile difference between ED physicians in the same facility-year. The mean of the dependent variable over the different time periods are displayed; the mean buprenorphine use in the month prior to the ED visit is 0.072. Heteroskedasticity-robust standard errors are clustered at the facility-by-quarter level.

Table 5: Physician Propensity Design: Instrumental Variable (2 Year)

Panel (a): Utilization

	Outpatient	SUD Treatment	Mental Health	Physical Health
	(1)	(2)	(3)	(4)
Buprenorphine	0.131	0.059	0.234***	0.142*
	(0.080)	(0.075)	(0.085)	(0.079)
Mean Dep. Var.	0.68	0.20	0.32	0.57
Observations (Patients)	142,880	142,880	142,880	142,880

Panel (b): Health Outcomes

	ED Visit	Opioid Overdose	Depression Score	Mortality, 2Y
	(1)	(2)	(3)	(4)
Buprenorphine	−0.056	0.014	1.751	−0.133*
	(0.038)	(0.009)	(2.747)	(0.076)
Mean Dep. Var.	0.113	0.002	11.102	0.094
Observations (Patients)	142,880	142,880	31,456	142,880

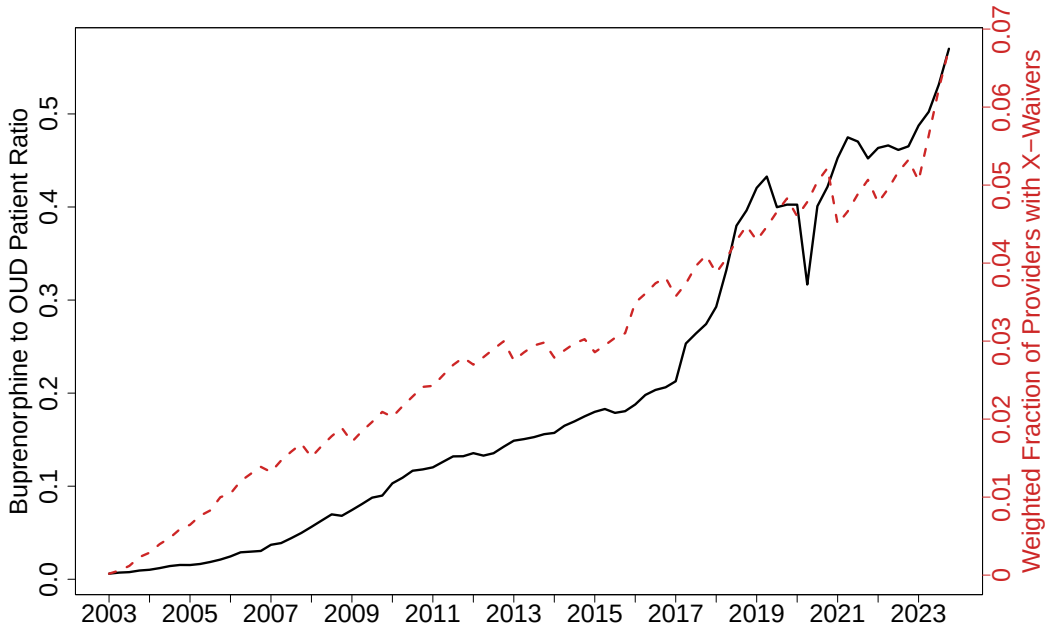
Panel (c): Economic Outcomes

	Vocational Rehabilitation & Employment	VA Disability Claim
	(1)	(2)
Buprenorphine	0.005	−0.017*
	(0.030)	(0.009)
Mean Dep. Var.	0.036	0.013
Observations (Patients)	142,880	121,185

Notes: This table presents the impact of provider propensity to emergency administer buprenorphine, $\tilde{Z}_{ij}$, on utilization (panel a), health (panel b), and economic (panel c) outcomes. All outcomes, with the exception of mortality, are measured as monthly averages over the 24 months following the first ED visit, conditional on the veteran being alive. This construction aligns the outcome definition with that used in the difference-in-differences specification of the facility adoption design, which leverages panel data at the month level. Utilization outcomes, ED visits, opioid overdose, and economic outcomes are all indicator variables. Depression score is the PHQ-9 score (max of 27) and conditional on having PHQ-9. All outcomes exclude the first 7 days immediately following the ED visit. Data on VA Disability is only available from 2004 to 2021, and thus estimated on patients overdosing between 2005 and 2019. Coefficients and standard errors are scaled by 0.05–approximately the 90th–10th percentile difference between ED physicians in the same facility-year. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

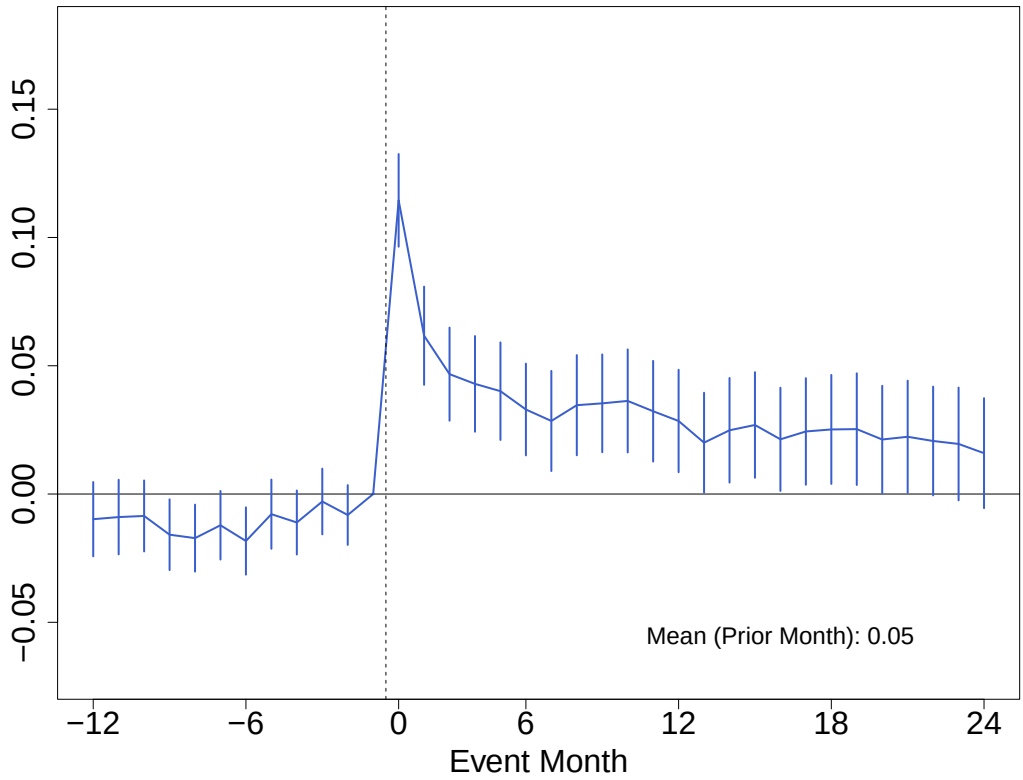
Figures

Figure 1: VA Adoption of Buprenorphine and X-Waivers



Notes: This figure shows the time series adoption of buprenorphine and X-waiver authorization between 2003 and 2023. The solid black line (left y-axis) is the number of unique patients on buprenorphine treatment (at least once) in each calendar quarter divided by the number of unique patients diagnosed with OUD in the prior 365 days. The dashed red line (right y-axis) corresponds to the fraction of SUD providers with X-waivers, where X-waiver is proxied by having prescribed buprenorphine at least once previously. This fraction is weighted by the number of SUD patients seen each provider.

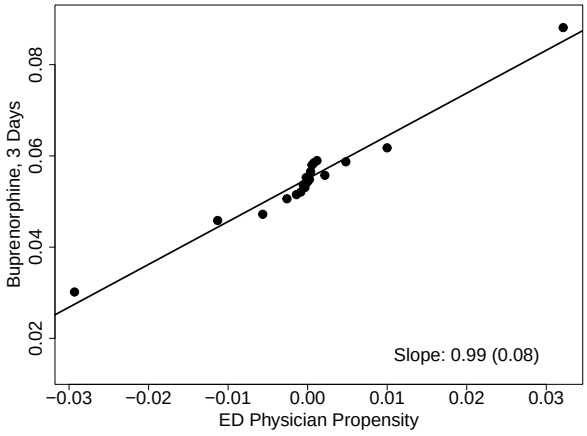
Figure 2: Buprenorphine Treatment



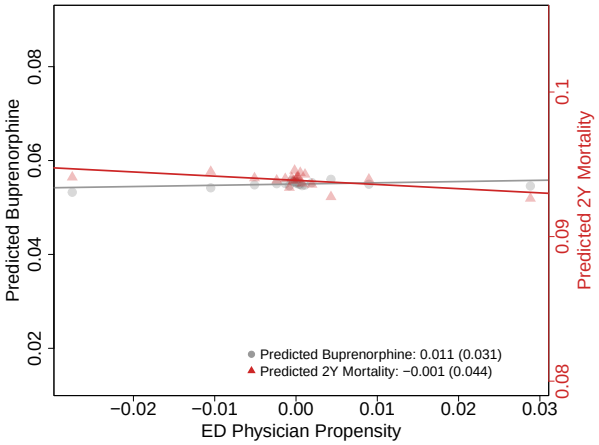
Notes: This figure displays event study coefficients estimated from Equation (1), where the outcome is an indicator for any buprenorphine utilization. The sample includes 7,517 patients who experienced their first opioid overdose at a VA emergency department between 2004 and 2022. Coefficients and standard errors are scaled by 0.05—-approximately the average increase in the treatment variable (the fraction of providers with an X-waiver) between 2004 and 2022, and also the 90th–10th percentile difference in the treatment variable across facilities in 2018. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level and 95%% confidence intervals are shown. The mean rate of buprenorphine use in the month prior to opioid overdose is displayed.

Figure 3: Physician Propensity Design: First Stage and Balance

(a) First Stage: Buprenorphine



(b) Balance: Predicted Buprenorphine and Mortality



Notes: This figure displays the first stage and balance test of the instrumental variable of the physician propensity design. Panel a shows a binscatter of an indicator variable for whether the patient receives buprenorphine within 72 hours of the ED on the IV. Panel b shows two binscatters with predicted buprenorphine within 72 hours and predicted 2-year mortality. Buprenorphine and mortality is predicted using all covariates in Figure A.4 in an OLS regression. All regressions are residualized for facility-quarter, facility-weekend-time of day, and 3-digit ICD-9 diagnosis codes. The estimated slope parameter and heteroskedastic-robust standard errors clustered at the facility-quarter level are displayed.

Appendix

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A. Appendix Tables and Figures

A.1 Appendix Tables

Table A.1: Buprenorphine Adoption Design: Robustness and Alternate Specifications

	Baseline ×0.05	State-by-Quarter ×0.05	Baseline ×0.034	Binary Adoption
	(1)	(2)	(3)	(4)
Buprenorphine	0.047***	0.050***	0.032***	0.028***
	(0.008)	(0.008)	(0.005)	(0.007)
Outpatient	0.022***	0.016*	0.015***	0.017*
	(0.008)	(0.009)	(0.006)	(0.009)
SUD Treatment	0.041***	0.045***	0.028***	0.018**
	(0.008)	(0.008)	(0.006)	(0.008)
Mental Health	0.023***	0.027***	0.016***	0.018**
	(0.007)	(0.008)	(0.005)	(0.008)
Physical Health	0.026***	0.021***	0.018***	0.013
	(0.008)	(0.009)	(0.005)	(0.009)
ED Visit	0.0002	0.004	0.0002	−0.001
	(0.005)	(0.006)	(0.003)	(0.005)
Opioid Overdose	0.002	0.003	0.001	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Depression Score	−1.315*	−2.819***	−0.901*	−0.638
	(0.691)	(1.095)	(0.473)	(0.661)
Mortality, 2Y	−0.037*	−0.035	−0.025*	−0.022
	(0.022)	(0.039)	(0.015)	(0.017)
Voc. Rehab. Emp.	0.013***	0.010***	0.009***	0.008**
	(0.004)	(0.004)	(0.002)	(0.003)
VA Disability	0.003	0.002	0.002	0.003
	(0.002)	(0.003)	(0.001)	(0.002)

Notes: This table presents difference-in-differences estimates for various robustness checks and alternate specifications for our facility buprenorphine adoption design. Column 1 presents our baseline DiD results. Column 2 includes state-by-calendar-quarter fixed effects instead of calendar-quarter fixed effects. Column 3 scales the baseline specification by 0.034—the average jump in in $XWaiver_Frac$ after adoption—for ease of interpretation. Column 4 replaces $XWaiver_Frac$ in Equation (1) with a binary indicator that equals 1 if the the index overdose event occurs in or after the facility adoption quarter. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

Table A.2: Physician Propensity Design: Reduced Form (2 Year)

All estimates are scaled by $\times 0.05$

Panel (a): Utilization

	Outpatient	SUD Treatment	Mental Health	Physical Health
	(1)	(2)	(3)	(4)
Provider Propensity	0.0062	0.0028	0.0112***	0.0068*
	(0.0038)	(0.0036)	(0.0039)	(0.0037)
Mean Dep. Var.	0.68	0.20	0.32	0.57
Observations (Patients)	142,880	142,880	142,880	142,880

Panel (b): Health Outcomes

	ED Visit	Opioid Overdose	Depression Score	Mortality, 2Y
	(1)	(2)	(3)	(4)
Provider Propensity	−0.0027	0.0007	0.1087	−0.0063*
	(0.0018)	(0.0004)	(0.1698)	(0.0036)
Mean Dep. Var.	0.112	0.002	11.102	0.094
Observations (Patients)	142,880	142,880	31,449	142,880

Panel (c): Economic Outcomes

	Vocational Rehabilitation & Employment	VA Disability Claim
	(1)	(2)
Provider Propensity	0.0002	−0.0007*
	(0.0014)	(0.0004)
Mean Dep. Var.	0.036	0.013
Observations (Patients)	142,880	121,185

Notes: This table presents the impact of provider propensity to emergency administer buprenorphine, $\tilde{Z}_{ij}$, on utilization (panel a), health (panel b), and economic (panel c) outcomes. All outcomes, with the exception of mortality, are measured as monthly averages over the 24 months following the first ED visit, conditional on the veteran being alive. This construction aligns the outcome definition with that used in the difference-in-differences specification of the facility adoption design, which leverages panel data at the month level. Utilization outcomes, ED visits, opioid overdose, and economic outcomes are all indicator variables. Depression score is the PHQ-9 score (max of 27) and conditional on having PHQ-9. All outcomes exclude the first 7 days immediately following the ED visit. Data on VA Disability is only available from 2004 to 2021, and thus estimated on patients overdosing between 2005 and 2019. Coefficients and standard errors are scaled by 0.05–approximately the 90th–10th percentile difference between ED physicians in the same facility-year. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

Table A.3: IV Estimates: Causal Impacts of 6 Months of Buprenorphine Adherence

Panel (a): Utilization

	Outpatient	SUD Treatment	Mental Health	Physical Health
	(1)	(2)	(3)	(4)
Buprenorphine	0.287*	0.129	0.516***	0.313*
	(0.170)	(0.159)	(0.187)	(0.164)
Mean Dep. Var.	0.68	0.20	0.32	0.57
Observations (Patients)	142,880	142,880	142,880	142,880

Panel (b): Health Outcomes

	ED Visit	Opioid Overdose	Depression Score	Mortality, 2Y
	(1)	(2)	(3)	(4)
Buprenorphine	−0.124	0.031	3.616	−0.293*
	(0.085)	(0.020)	(5.737)	(0.169)
Mean Dep. Var.	0.112	0.002	11.102	0.094
Observations (Patients)	142,880 142,880	31,449	142,880	

Panel (c): Economic Outcomes

	Vocational Rehabilitation & Employment	VA Disability Claim
	(1)	(2)
Buprenorphine	0.011	−0.032*
	(0.065)	(0.019)
Mean Dep. Var.	0.036	0.013
Observations (Patients)	142,880	121,185

Notes: This table presents the IV impact of being on consecutive buprenorphine treatment for the first six months following the ED event (i.e., at least once a month, monthly) on utilization (panel a), health (panel b), and economic (panel c) outcomes. We instrument for consecutive buprenorphine treatment in the first six months with $\tilde{Z}_{ij}$. The first stage relationship can be found in Table 4 column 3. All outcomes, with the exception of mortality, are measured as monthly averages over the 24 months following the first ED visit, conditional on the veteran being alive. This construction aligns the outcome definition with that used in the difference-in-differences specification of the facility adoption design, which leverages panel data at the month level. Utilization outcomes, ED visits, opioid overdose, and economic outcomes are all indicator variables. Depression score is the PHQ-9 score (max of 27) and conditional on having PHQ-9. All outcomes exclude the first 7 days immediately following the ED visit. Data on VA Disability is only available from 2004 to 2021, and thus estimated on patients overdosing between 2005 and 2019. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

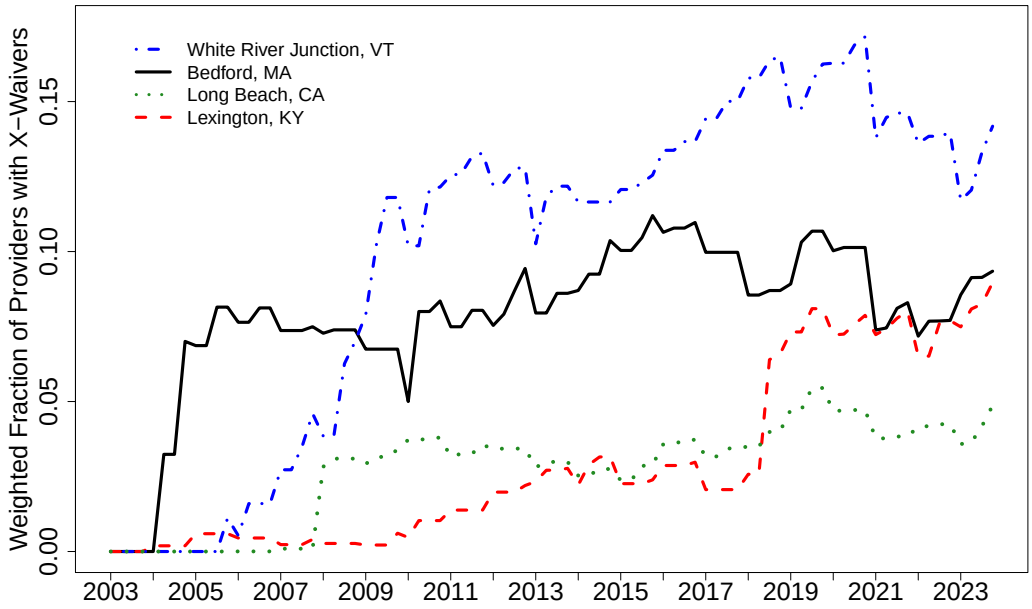
Table A.4: Buprenorphine Adoption Design: Methadone Treatment

	Dependent variable: Methadone Treatment (×0.05)				
		Event Month:			
	2-Year DiD	1-6	7-12	13-18	19-24
	(1)	(2)	(3)	(4)	(5)
$XWaiver_Frac$	0.006	0.010*	−0.001	−0.006	−0.009
	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)
Mean Dep. Var. (Prior Month)	0.050	0.050	0.050	0.050	0.050
Observations (Patient-Month)	252,838	252,838	252,838	252,838	252,838

Notes: This table presents the impact of $XWaiver_Frac$ on methadone treatment in opioid treatment programs. This table is displayed in the same format as Table 2. Column 1 presents the average treatment effect over 24 months (aggregate version of Equation (1) where event time indicators are replaced with a single post overdose indicator). Columns 2 to 5 presents the average event study coefficients over six month horizons. For instance, column 2 presents the average of event study coefficients in post-period months 1 to 6 and its associated standard error. An observation is a patient-month. Coefficients and standard errors are scaled by 0.05—-approximately the average increase in the treatment variable (the fraction of providers with an X-waiver) between 2004 and 2022, and also the 90th–10th percentile difference in the treatment variable across facilities in 2018. Heteroskedasticity-robust standard errors are clustered at the facility-by-(overdose) quarter level.

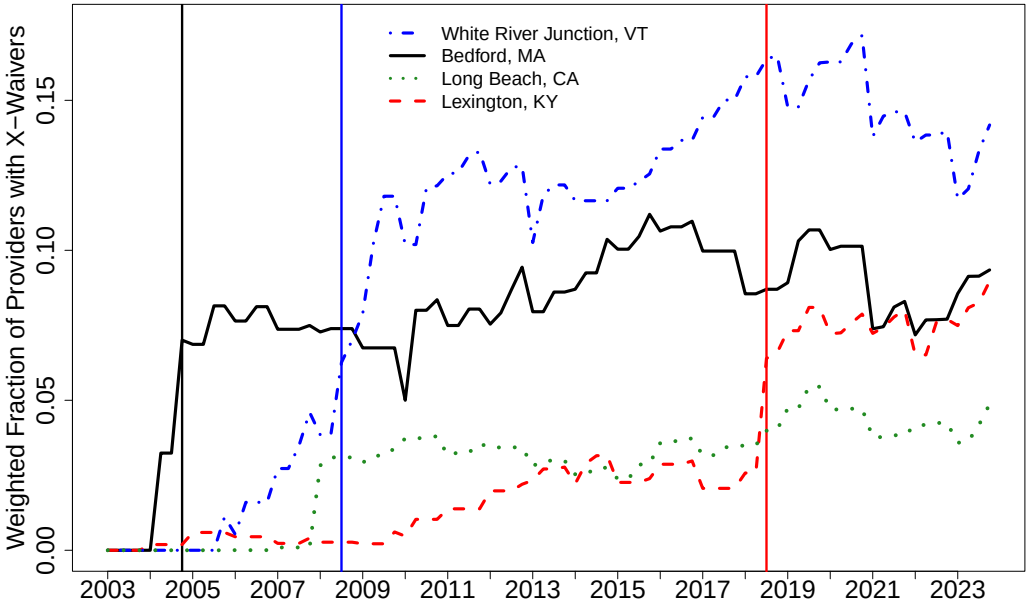
A.2 Appendix Figures

Figure A.1: X-Waiver Fraction, Selected VA Facilities



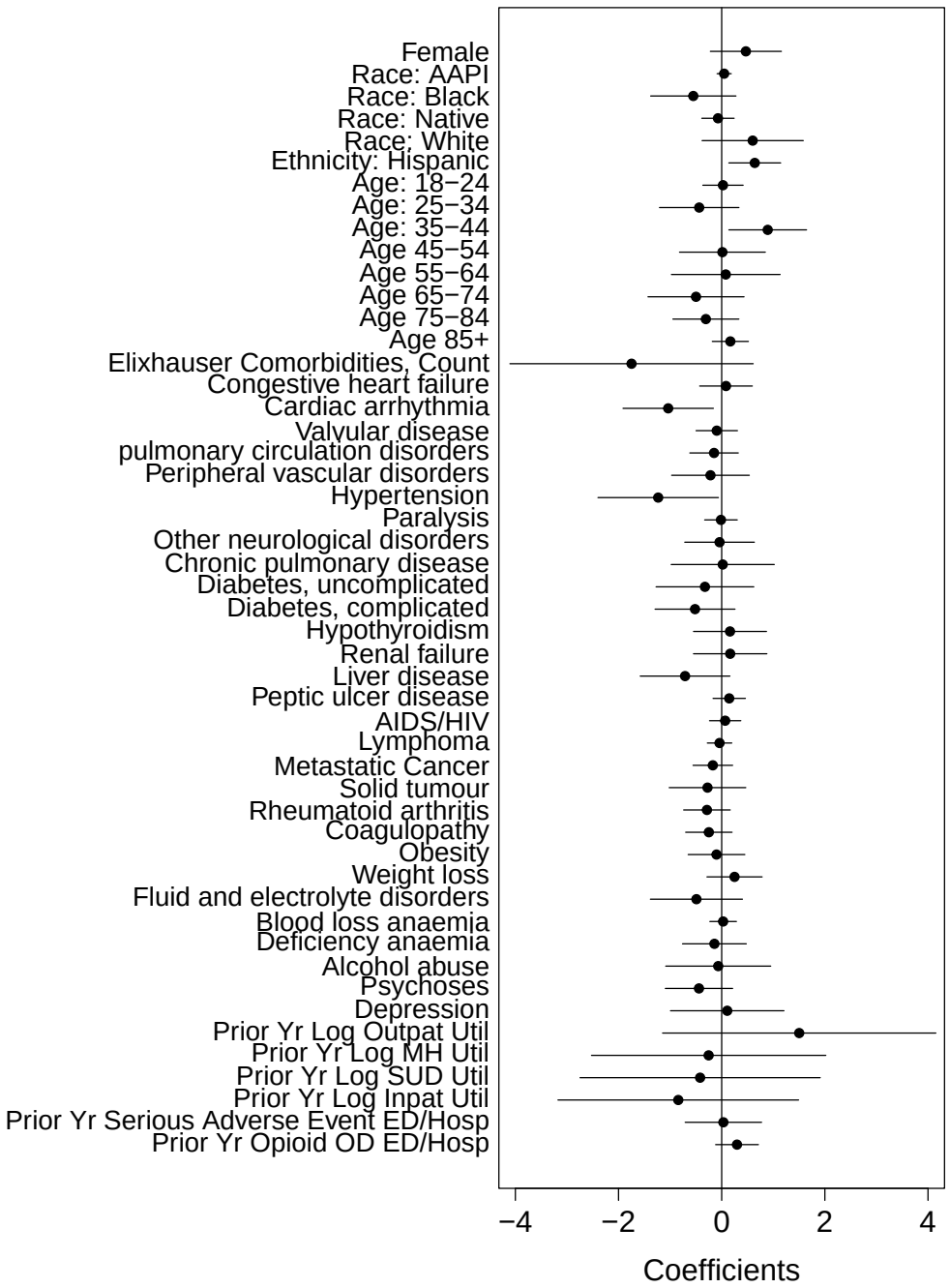
Notes: This figure shows the time series adoption of X-waiver authorization among SUD providers, $XWaiver_Frac$, across select VA facilities (VA stations). The aggregate VA national time series is presented in Figure 1. This figure shows that facilities differ substantially in the timing of adoption, and this adoption is often discrete.

Figure A.2: Binary Buprenorphine Adoption, Selected VA Facilities



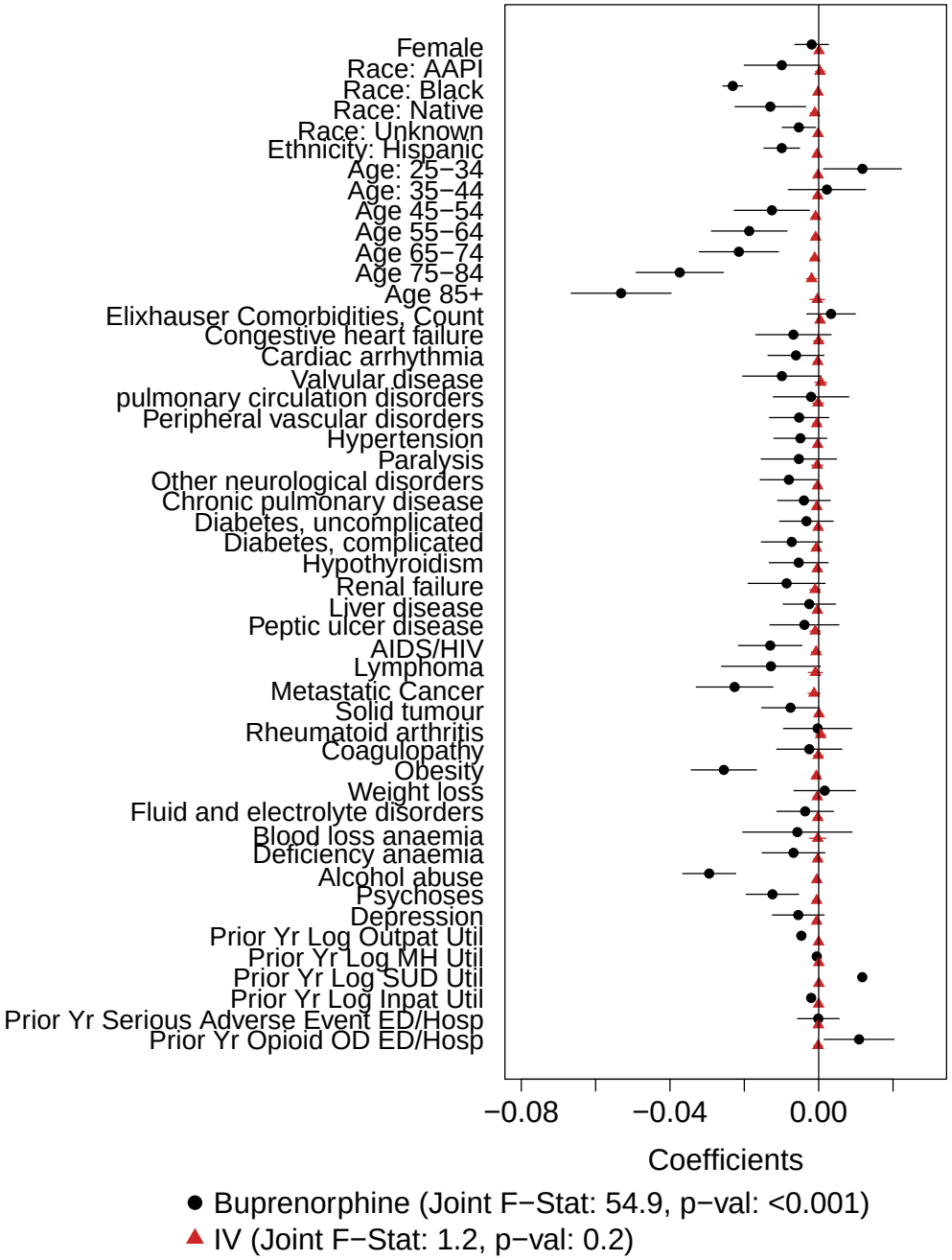
Notes: This figure shows the time series adoption of X-waiver authorization among SUD providers, $XWaiver_Frac$, across select VA facilities (VA stations), as well as their binary adoption date in vertical lines. For each facility, we code their adoption date as the first quarter where $XWaiver_Frac > 0.05$, and stays above 0.05 for four consecutive quarters. In this example, Bedford, MA (black) has an adoption date of 2004 Q4, White River Junction, VT (blue) has an adoption date of 2008 Q3, Lexington, KY has an adoption date of 2018 Q3, and Long Beach, CA is a never-adopter. Out of 129 VA facilities, 48 never adopt by the end of 2022. There is substantial heterogeneity in adoption timing. Among ever-adopters, the interquartile range is approximately six years (2013 Q4 and 2019 Q3).

Figure A.3: Balance: Are Patient Characteristics Associated with Buprenorphine Adoption?



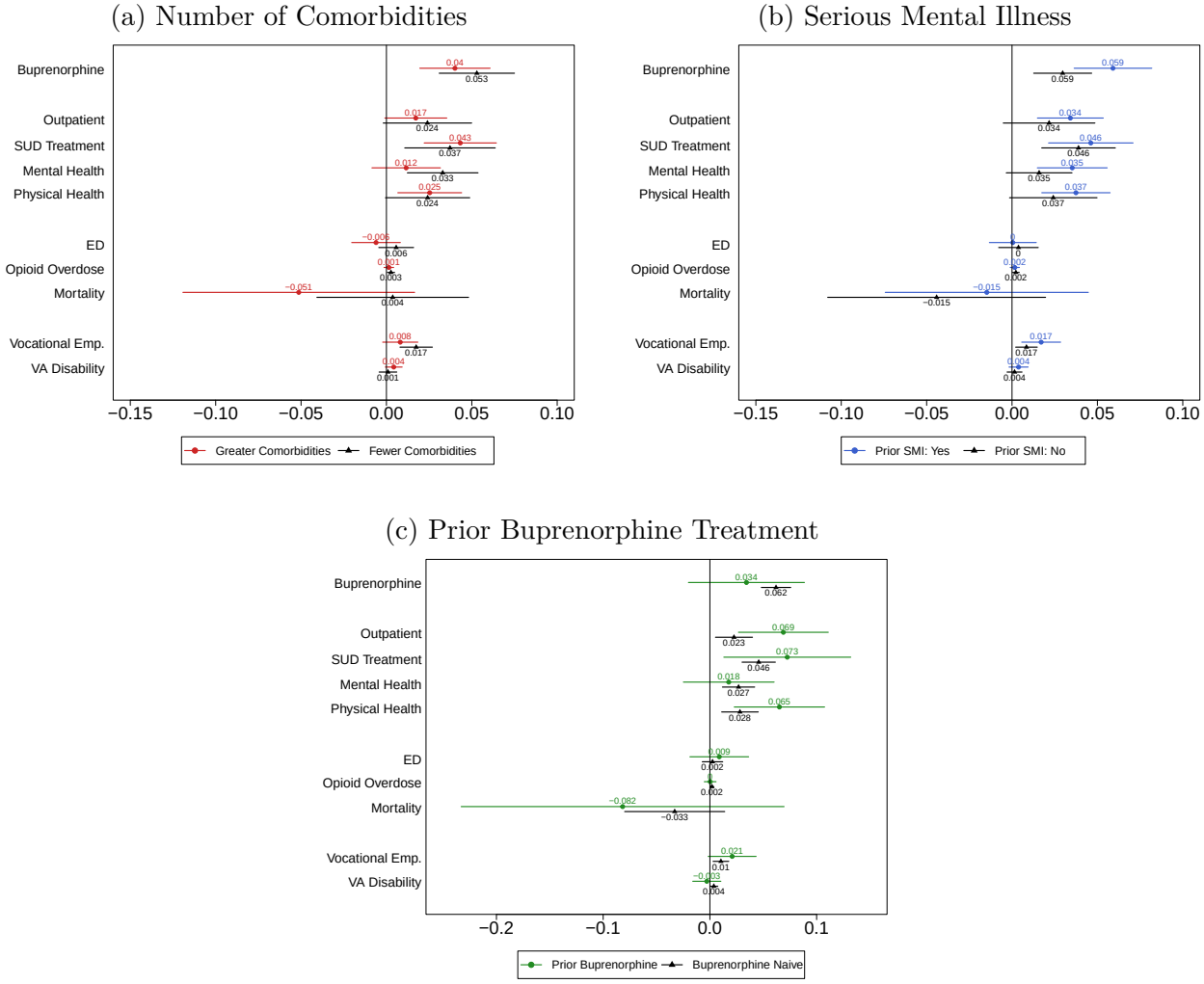
Notes: This figure tests whether patient characteristics among first opioid overdoses in EDs are associated with facility adoption rate $XWaiver_Frac$. Specifically, we regress each outcome Y_i on the treatment variable $XWaiver_Frac_{s(i),t_0(i)}$, controlling for facility fixed effects $\alpha_{s(i)}$ and overdose quarter fixed effects $\lambda_{t_0(i)}$. All non-binary outcomes are standardized.

Figure A.4: Physician Propensity Design: Covariate Balance



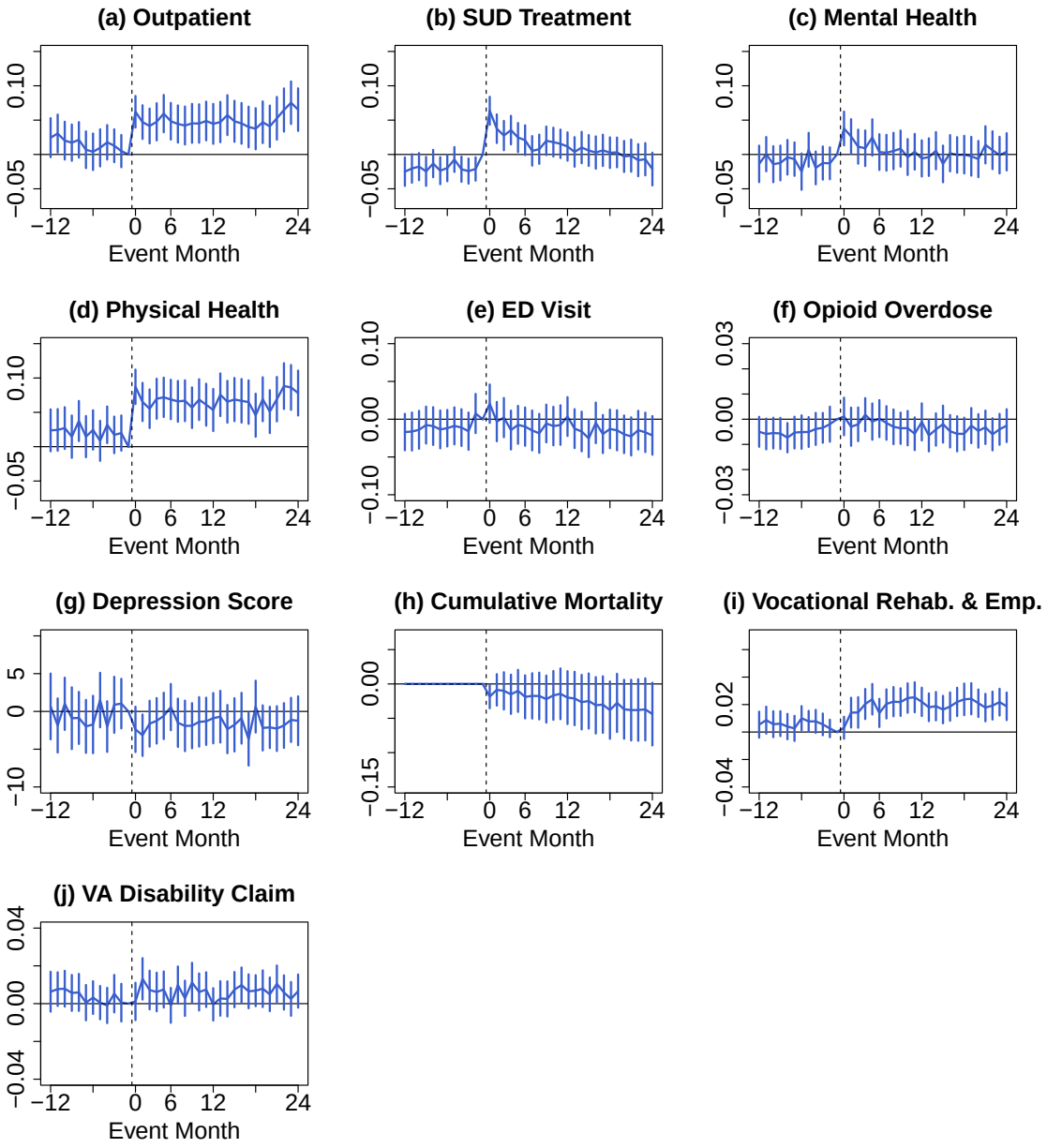
Notes: This figure displays the estimated coefficients and 95% confidence interval from two regressions. The black circles are coefficients from a regression of our treatment variable (buprenorphine within 72 hours) on a set of covariates. The red triangles are coefficients from a regression of our instrumental variable (ED physician propensity to administer buprenorphine within 72 hours) on the same covariates. Heteroskedastic-robust standard errors are clustered at the facility-quarter level. The F statistic corresponding to a joint test on all covariates is displayed.

Figure A.5: Heterogeneity



Notes: This figure shows heterogeneous impacts of expanding the fraction of SUD providers with X-waiver authorization by 5% for various subpopulations. Panel (a) splits the population by above and below median (3) Elixhauser comorbidities based on diagnoses in the year prior to the opioid overdose. Panel (b) splits the population based on whether the patient was diagnosed with serious mental illness (SMI) in the year prior to the opioid overdose. Panel (c) splits the population based on whether the patient had buprenorphine treatment in the year prior to the opioid overdose. The estimated coefficients from Equation (1) for each separate subpopulation is plotted and scaled by 0.05. Depression score outcomes are very noisy and skews the figures and are thus not plotted. The estimates on average PHQ-9 depression score are −0.18 (0.12) and −0.30 (0.16) for greater and fewer comorbidities, −0.26 (0.10) and 0.53 (0.27) for those with and without prior SMI, and −0.07 (0.20) and −0.27 (0.11) for those with and without prior buprenorphine treatment, respectively.

Figure A.6: Buprenorphine Adoption Design: Event Study Plots



Notes: This figure displays the estimated event study coefficients, β_k and 95% confidence interval from Equation (1). Heteroskedastic-robust standard errors are clustered at the facility-level.

B. Measuring ED Provider Buprenorphine Prescribing Propensity

To construct provider propensities, we use a sample of all 1,650,803 ED visits between 2003 and 2024 by 188,556 unique patients with a prior-year OUD diagnosis. This approach is motivated by the fact that a substantial share of ED visits by patients with diagnosed OUD are related to opioid use complications—such as overdose, withdrawal, or comorbid conditions frequently caused or exacerbated by opioid use—making buprenorphine initiation clinically relevant in many of these encounters.

We estimate the following regression to isolate residual variation in buprenorphine initiation after accounting for quasi-random assignment of patients with the same facility, time, and diagnosis:

$$Bup_i = \alpha_{st} + \lambda_{swd} + \gamma_{diagnosis} + \epsilon_i, \tag{5}$$

where Bup_i is an indicator for whether patient i received buprenorphine within 72 hours of their ED visit; α_{st} denotes facility-by-quarter fixed effects; λ_{swd} denotes fixed effects for facility-by-weekend-status-by-time-of-day[13]; and $\gamma_{diagnosis}$ captures 3-digit ICD-9 diagnosis fixed effects.

Using the residuals from Equation (5), we construct each patient i's provider j's emergency buprenorphine propensity, Z_{ij}, as a leave-one-out jackknife average of the residualized buprenorphine receipt in that year-quarter:

$$Z_{ij} = \frac{1}{N_{-i,j}} \sum_{i' \in \mathbb{J} \setminus i} \hat{\epsilon}_{i'}, \tag{6}$$

where $\hat{\epsilon}_{i'}$ is the residual from Equation (5) for encounter i', $\mathbb{J}$ is the set of all ED encounters with OUD patients treated by provider j in each quarter, and $N-i,j$ is the number of such

[13]Time of day controls are meant to approximate ED physician shifts (7am–3pm, 3pm–11pm, 11pm–7am) and helps capture variation in provider assignment.

encounters excluding patient i. Finally, we shrink each provider's mean residual towards that facility-quarter average using an empirical Bayes adjustment. The resulting instrument, $\tilde{Z}_{ij}$, is a precision-weighted propensity that remains high for frequently observed providers, but is partly pooled towards the facility-quarter mean for low-volume providers.

C. Cost Benefit Analysis

In this appendix we conduct cost benefit analysis for increasing the fraction of SUD providers with an X-waiver in a facility by 5%. All calculations only consider statistically significant outcomes and are at the individual patient-level.

Costs We consider costs from medical spending and buprenorphine utilization. For each patient, we calculate their total medical costs (both inpatient and outpatient) over the first year, the first two years, and the first three years. We use VA-calculated "average cost" which provides aggregate-level VA expenditures to individual patient encounters based on characteristics of the encounter (e.g., length of stay, diagnosis-related group, intensive care days, procedure codes, etc.; Wagner, Chen and Barnett, 2003). These costs include all costs of providing the care, including administrative overhead and staffing labor costs. Buprenorphine costs are also calculated at the individual-level, and is the sum of all dispensed buprenorphine over each time horizon. These costs come from the VA Federal Supply Schedule, which is the VA contracting cost for the specific drug (e.g., formulation and dose). All dollars are real 2024 dollars.

While medical and drug spending are monetary "costs", increasing healthcare utilization among sick, disadvantaged populations is desirable and could be viewed as a benefit, especially if it improves other non-mortality health outcomes.

Benefits Benefits come from life years saved (LYS) valued at standard value of a statistical life year (VSLY) estimates. We estimate an event study regression with cumulative mortality as the outcome (Equation (1)) and integrate the area under the curve to arrive at LYS over different time horizons. This exercise assumes that there are no additional survival gains beyond the considered time horizon. Then we multiply the LYS by conventional values of VSLY (e.g., $200,000, $300,000, $400,000).

Table C.1: Cost Benefit Analysis

		Time Horizon: Year 1 (1)	Year 2 (2)	Year 3 (3)
Costs:				
Medical Spending		7,752	8,513	7,572
Buprenorphine		306	440	515
Benefits:				
Life Years Saved		0.0112	0.0192	0.0347
Cost - Benefit:	VSLY: 200K	5,824	5,110	1,148
	VSLY: 300K	4,706	3,189	-2,322
	VSLY: 400K	3,589	1,267	-5,792

Notes: This table displays the cost benefit analysis of scaling up X-waiver adoption by 0.05 (our main treatment effect) for a single opioid overdose patient. Columns 1 to 3 correspond to cumulative costs and benefits over 1, 2, and 3 years. Costs include total medical spending (inpatient and outpatient) as well as buprenorphine prescriptions. Medical costs come from VA estimates that distribute aggregate-level VA expenditures to individual patient encounters using visit characteristics. Buprenorphine costs are drug-specific (e.g., formulation and dose) VA contract costs from the Federal Supply Schedule. Benefits include survival gains (i.e., life years saved), which we monetize using three different value of a statistical life (VSLY). See text for more details. All dollars are real 2024 dollars.