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INSURANCE COVERAGE AND PROVISION OF OPIOID TREATMENT: EVIDENCE FROM MEDICARE

Denis Agniel
Jonathan H. Cantor
Johanna Catherine Maclean
Kosali I. Simon
Erin Taylor

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ABSTRACT

Opioid overdose deaths in older adults increased substantially over the past two decades. This increase occurred despite the availability of effective treatments. Methadone, one of three medications approved for opioid use disorder (OUD) treatment, was not covered by Medicare — the primary insurer of older Americans — for OUD until 2020. We study the response of opioid treatment programs (OTPs), the only healthcare providers that can dispense methadone for OUD in the U.S., to this policy change using administrative data and a difference-in-differences framework. We examine provider acceptance of Medicare payment and the number of treatment episodes, before and after the policy change, in OTPs relative to other substance use disorder treatment facilities. Our findings show a surge in Medicare acceptance by OTPs and an increase in the number of treatment episodes post-policy, signalling the importance of insurance for OUD treatment provision.

Denis Agniel
RAND Corporation
dagniel@rand.org

Jonathan H. Cantor
RAND Corporation
1776 Main Street
Santa Monica, CA 90401
jcantor@rand.org

Johanna Catherine Maclean
Schar School of Policy and Government
George Mason University
Mason Square
Van Metre Hall
3351 Fairfax Drive
Arlington, VA 22201
and NBER
jmaclea@gmu.edu

Kosali I. Simon
O'Neill School of Public and Environmental Affairs
Indiana University
1315 East Tenth Street
Bloomington, IN 47405-1701
and NBER
simonkos@indiana.edu

Erin Taylor
RAND Corporation
1776 Main St
Santa Monica, CA 90407-2138
Erin_Taylor@rand.org

1 Introduction

The United States is in the midst of an opioid crisis (Office of the Surgeon General, 2018). In 2022, there were 79,770 fatal opioid overdoses (National Center for Health Statistics, 2023). These numbers are preceded by a decades long rise in fatal opioid overdoses: well over 700,000 Americans have died from opioid overdose since 1999 (Centers for Disease Control & Prevention, 2023). Numerous policies at all levels of governments have been adopted in attempts to address the health harms arising from opioid use. In this paper, we study the impact of a major recent policy change: the addition of methadone, an effective treatment for opioid use disorder (OUD), to Medicare's covered services. We examine the extent to which Medicare's January 2020 coverage of methadone for OUD has affected provider acceptance of Medicare, a first step in understanding whether removing this major insurance barrier can reduce overdose mortality.

The origins of the opioid crisis are complex, but the crisis is generally believed to have emerged as a result of the over−prescription of highly addictive opioid medications by healthcare professionals supported by aggressive and misleading marketing tactics of opioid companies beginning in the 1990s (Alpert et al., 2022; Maclean et al., 2021, 2022). Early in the crisis, prescription opioids were the substance most commonly misused. Over time, consumers increasingly turned to more harmful drugs: initially heroin and then fentanyl and its synthetic analogs. The cost of the crisis, which shows no sign of abating, to the U.S. is estimated to be as much as $1.3 trillion per year (Florence et al., 2020).[1]

While the demographics of the modal person consuming opioids non−medically has changed over time, no group is immune to OUD (Maclean et al., 2021). Recently, attention has turned to the costs of opioid use for older Americans (Carew and Comiskey, 2018). This attention is likely warranted as opioid−related deaths have skyrocketed in this age group: the annual age−adjusted death rates from non−methadone synthetic opioids increased from 0.11 to 2.85 − 2,940% − among those 65 years and older between 2000 and 2020 (Kramarow and Tejada-Vera, 2022). In 2021, over one million Medicare beneficiaries lived with OUD (Office of Inspector General, 2022), and the prevalence of OUD among older adults tripled between 2013 and 2018 (Shoff et al., 2021).[2] Increases in OUD treatment use among older Americans mimic these trends in overdose and OUD, though the treatment increases are not nearly as stark, which hints at additional barriers to treatment within this population. Figure 1 shows the share of adults 65 years and older receiving treatment in residential and outpatient facilities for OUD between 2000

[1] Inflated from the original value ($1.02 trillion in 2017) using the Consumer Price Index.

[2] Increases in older adult OUD rates and overdoses could be driven by various factors. Persons with OUD are living to older ages, diagnosis of OUD is increasing overtime, and so forth.

and 2021.[3] Over this time period, the share of older adults in treatment for OUD more than quadrupled from 0.3% in 2000 to 1.3% in 2021.

These statistics are concerning as the U.S. population is aging − 21% of the population will be over 65 in 2030 (Vespa, 2018). Medicare Part D, which covers medications dispensed in outpatient retail pharmacies, reimburses many opioid medications at low cost−sharing, and chronic pain (a condition often treated with opioids) is common among older adults (Zelaya et al., 2020), which may place some older adults at elevated risk for OUD (Han et al., 2017; Schepis et al., 2018).

While OUD is a devastating medical condition, effective treatment options are available, with medications ('MOUD') playing a central role. MOUDs are associated with declines in overdose−related healthcare, morbidity, and mortality (Mohlman et al., 2016). Methadone, a MOUD that is dispensed only through certified opioid treatment programs (OTPs) (Alderks, 2017; Yarmolinsky et al., 1995), is approved by the Food & Drug Administration (FDA) (2019). The delivery of methadone for OUD is expensive: annual total (medication and ancillary) costs are estimated to be $6,552 per patient (National Institute on Drug Abuse, 2021).[4] Without insurance coverage, older Americans with OUD may be unable to afford methadone treatment as many have constrained incomes: in 2021 10% of Americans 65 years and older had incomes below the federal poverty line (U.S. Census Bureau, 2022) and cost is a key barrier to treatment (Ali et al., 2017).[5]

Historically, Medicare did not cover methadone for OUD treatment, although this medication has been approved by the FDA for OUD treatment since 1972 − far longer than any other approved MOUD. The federal SUPPORT Act of 2018 created a new Medicare Part B[6] benefit whereby OUD treatment provided by OTPs, including methadone, would be newly covered as a bundled (medication and other treatment) payment for outpatient substance use disorder (SUD) treatment in traditional Medicare and in Medicare

[3]Authors' analyses of the Treatment Episode Database, described in more detail in Section 3.

[4]Methadone for OUD is different from many other medications, including other MOUDs, in that several ancillary services such as urine toxicology screening are required. The costs of methadone the medication are relatively low, but the other costs of administering this mediation are more substantial: methadone the medication comprises 3.8% of the total cost with physician billing, pharmacy costs, and urine testing reflecting 9.8%, 39.8%, and 46.7% of the total cost respectively (Zaric et al., 2012).

[5]Prior to becoming age−eligible for Medicare, low−income people could have qualified for Medicaid, a means−tested insurance program for the poor which covers methadone for OUD in most states. Once turning 65, most of these individuals would have transitioned to Medicare.

[6]Medicare Part B covers outpatient professional treatment not included in Medicare Part A; Part A covers inpatient hospital care, skilled nursing facility care, hospice care, and home healthcare. Medicare Part D covers other MOUDs (described in Section 2). Methadone (the medication alone, rather than in combination with the other services that are needed for methadone OUD treatment) can also be used to treat pain and was covered for this indication by Medicare Part A and D from program inception or from the medication's FDA approval date onward, thus prior to the 2020 policy change.

Advantage plans as of January 2020 (Congressional Research Service, 2020). This change was expected by addiction treatment experts to fundamentally reshape the landscape for OUD−related methadone care within Medicare (Felix et al., 2020).

From the perspective of OTPs, the SUPPORT Act reflects a massive increase in the size of the insured market. Medicare is the largest payer in the U.S. healthcare market accounting for 21% of expenditures (Centers for Medicare & Medicaid Service, 2023) and covered 65.7 million people in March 2023 (Centers for Medicare & Medicare Services, 2023). The U.S. population's median age continues to rise and, as a result, Medicare will cover increasingly more people going forward, 93 million by 2050 according to some estimates (Kaiser Family Foundation, 2023). The Medicare weekly reimbursement rate for OTP methadone treatment was $248.75 (medication and other treatment in the bundle) in 2023 (Centers for Medicare & Medicaid Services, 2022) and was substantially higher than Medicaid but somewhat lower than private insurance rates.[7] For example, Clemans-Cope et al. (2022) show that in 2021 Medicaid methadone for OUD treatment reimbursement rates were 56% of Medicare rates. Given the relatively high reimbursement rate of Medicare for methadone and the large size of the Medicare market, OTPs are likely to respond to the 2020 policy change in economically meaningful ways.

We study the response of OTPs to this massive change in the U.S. opioid treatment market embodied in the reimbursement for OTP methadone treatment in Medicare. We do so by examining trends in facility−reported acceptance of Medicare as a form of payment by OTPs, the treatment group, before and after the policy change of January 2020, in a difference−in−differences (DID) study design that uses non−OTP substance use disorder treatment facilities (SUDTFs) as the comparison group. We show that, prior to the coverage change in 2020, these two groups of SUDTFs followed similar trends in acceptance of Medicare. Immediately following the policy change, acceptance of Medicare by OTPs surged: the share accepting this payment form increased by 41.4 percentage points, representing a near doubling. Treatment episodes in OTPs among older adults

[7] As there is no existing source of price for private insurance reimbursement for methadone OUD treatment, we report here the prices in publicly−released commercial reimbursement data occurring in 2023 from one large insurer in the U.S., Humana Inc. We isolate likely providers of methadone for OUD treatment based on specialty and historical treatment. Using these data, we estimate that the average (unweighted by volume) weekly negotiated commercial insurance reimbursement rate for methadone and associated treatment for OUD care was $254.84 (excluding the top and bottom 1% of reimbursement rates) to $318.67 (including all observations meeting our inclusion criteria). Thus, private insurance appears to reimburse at moderately higher rates than Medicare, which is in line with the relative prices for general healthcare (Lopez et al., 2020). We thank Benjamin Chartock and Raman Singh for excellent collaboration and assistance with this analysis. Medicare reimbursement for buprenorphine and naltrexone are higher than for methadone (Centers for Medicare & Medicaid Services, 2022), but no comparable data are available in the commercially released prices for buprenorphine and naltrexone so we are not able to make a private to Medicare comparison.

with OUD increased by nearly 24% post−2020. We test for potential spillovers to other markets and other margins along which OTPs could respond to the policy change, and document heterogeneity in policy response by ownership status.

2 Background

2.1 Opioid use disorder treatment

MOUDs in combination with counseling (e.g., cognitive behavioral therapy) are considered gold standard treatments for OUD. Three MOUDs are currently approved by the FDA for OUD treatment: buprenorphine, methadone, and naltrexone. Our study focuses on a policy that added coverage of methadone for OUD treatment within Medicare. Prior to this policy, Medicare covered both buprenorphine and naltrexone. Thus, the policy expanded coverage such that Medicare beneficiaries had, for the first time, coverage for all three FDA−approved MOUDs.

The effectiveness of MOUDs for treatment of OUD is well established in numerous medical studies (Mattick et al., 2009; Murphy and Polsky, 2016; Ali et al., 2017; Sordo et al., 2017; World Health Organization, 2021; Onuoha et al., 2021). Because there is no 'one−size−fits−all' OUD treatment (Han et al., 2022), patients may be better suited to one medication over the other. Comparisons suggest, on average, that these medications are roughly equally effective (Mattick et al., 2008; Lee et al., 2018). For some patients, methadone is the optimal treatment (Lenné et al., 2001; Ali et al., 2017), and methadone allows for more flexible medication dosing than other MOUDs (Mattick et al., 2008). Methadone may be less likely to precipitate withdrawal in patients using fentanyl (Varshneya et al., 2022); this potential benefit is important given the increasing prevalence of fentanyl use.[8] Given heterogeneity across patients, our analysis cannot speak to whether methadone is optimal for the average Medicare beneficiary. Instead we argue, as do addiction treatment experts, that providing patients with ready access to all three MOUDs is preferable to providing access to only a subset of medications.

The Medicare 2020 change, by covering methadone for OUD, expanded the available treatment options for beneficiaries and has the potential to allow better patient−treatment matching. Some areas of the country have limited access to buprenorphine and naltrexone (Abraham et al., 2019; Harris et al., 2020; Langabeer et al., 2020), for patients in such localities, methadone may be the only feasible treatment option. Indeed, existing

[8]Methadone may pose more interactions with other medications, which could limit use for some elderly patients as older persons are more likely to take medications (Konakanchi and Sethi, 2023).

research establishes that county−level factors are associated with OTP acceptance of Medicare. For example, Harris et al. (2023) find that counties with a higher share of rural residents were less likely to contain an OTP that accepted Medicare, and that regional differences existed across states in OTP Medicare acceptance.

MOUDs work differently to reduce OUD symptoms (i.e., euphoria, withdrawal, cravings). Buprenorphine is a partial opioid agonist and methadone is a full opioid agonist. These MOUDs act on the same opioid receptors in the brain as opioids, but produce a less intense sense of euphoria, and reduce withdrawal symptoms and cravings. Naltrexone is an opioid antagonist and blocks activation of opioid receptors in the brain, preventing any opioid from producing euphoria, highs, or other rewarding effects.

Healthcare professionals prescribe buprenorphine (patients can fill the prescription at a retail pharmacy and take the pill in their own home) and dispense naltrexone (typically administered with a monthly injection) in outpatient settings (e.g., physician offices). Prior to the Consolidated Appropriations Act of 2023, healthcare professionals were required to receive training and obtain a waiver from the Drug Enforcement Agency (DEA) to prescribe buprenorphine, the Act removed this requirement. No specialized training is required for naltrexone among healthcare practitioners licensed to prescribe medications. Methadone for OUD is dispensed only in certified OTPs, with patients required to go to the OTP each day or multiple days per week to receive treatment. Patients must have an OUD diagnosis before receiving treatment.[9]

There are approximately 16,000 SUDTFs in the U.S., with roughly 1,700 OTPs (Harris et al., 2023). The procedure for opening an OTP is cumbersome and governed by the Certification of Opioid Treatment Programs, 42 Code of Federal Regulations 8 (Substance Abuse and Mental Health Services Administration, 2023; Polsky et al., 2020). The regulation creates a system to certify and accredit OTPs in the U.S.[10] To provide OTP care, SUDTFs must be certified by the Substance Abuse and Mental Health Services Administration (SAMHSA) and the DEA, accredited by an independent accreditation body that is approved by SAMHSA (Substance Abuse and Mental Health Services Administration, 2023; Polsky et al., 2020), and meet other requirements including: i) licensed by the state, ii) registered with the the FDA through the local DEA office, and iii) meet other state−specific requirements (Substance Abuse and Mental Health Services Admin-

[9]During the COVID−19 pandemic, some restrictions were relaxed (Amram et al., 2021).

[10]Accreditation is a peer−review process that evaluates an OTP against SAMHSA's opioid treatment standards and the accreditation standards of SAMHSA−approved accrediting bodies (Substance Abuse and Mental Health Services Administration, 2023). The accreditation process includes onsite visits by specialists with experience in opioid treatment medications and related treatment activities. The purpose of these site visits is to ensure that OTPs meet specific, nationally accepted standards. OTP certification must be renewed every year or every three years.

istration, 2023). OTPs are permitted to administer and dispense methadone and other FDA−approved medications for OUD treatment (10% of buprenorphine patients receive the medication at OTP (Polydorou et al., 2017)). Patients receiving care from OTPs can receive counseling and other therapies, and counseling on the prevention of human immunodeficiency virus and other infectious diseases.

2.2 Mixed−payer market

Our empirical analysis is motivated by the Sloan et al. (1978) model, which was first used to study physician Medicaid participation in mixed−payer markets. Multiple studies have used the model to study how changes in Medicaid programs and insurance policies impact the behavior of physicians and other healthcare professionals (Sloan et al., 1978; Baker and Royalty, 2000; Garthwaite, 2012; Buchmueller et al., 2016; Carey et al., 2020). Maclean et al. (2018) and Hamersma and Maclean (2021) use the model to test whether insurance policy changes impact SUDTFs (not specifically OTPs).

We modify the canonical Sloan model to draw testable hypotheses regarding how the 2020 Medicare policy impacts OTP behavior. OTPs provide care in a market in which patients differ by, among other factors, their insurance coverage, which leads to variation in marginal revenue (MR). Pre−policy, from the perspective of an OTP, there are two types of insured patients – private and Medicaid[11] enrollees. The market also includes uninsured patients for OTP treatment. We consider insurance from the OTP perspective, thus the uninsured market includes the ('truly') uninsured who do not have insurance coverage and will rely on free care; Medicare beneficiaries or patients whose coverage does not include methadone for OUD; and patients who will self−pay (those not covered by insurance or choosing not to use insurance). Medicare beneficiaries, following the policy change, transition from uninsured to 'newly' insured, creating a new market sector: Medicare−financed methadone treatment for OUD.

Patients can be ranked from highest to lowest reimbursement rate based on their insurance coverage. (For simplicity, we assume homogeneous treatment costs across patients.) Pre−policy, the ranking is private, Medicaid, and uninsured (Medicare, uninsured who do not pay, and self−pay). Post−policy, the ranking is as follows: private,

[11]Nearly all state Medicaid programs covered methadone for OUD by 2020. The Kaiser Family Foundation (ND) reports that all but ten states covered methadone for OUD in 2018 (Alaska, Idaho, Kansas, Kentucky, Louisiana, Nebraska, South Dakota, South Carolina, Tennessee, and Wyoming) and in 2022 there were just two states (Nebraska and Wyoming) not covering this treatment. As we show in Section 5, our results are not sensitive to excluding these states.

Medicare,[12] Medicaid, and uninsured (uninsured who do not pay and self−pay).[13] Figure 2 depicts the modified Sloan model. The solid blue line shows the post−policy market and the dashed blue line shows the pre−policy market. OTPs face a kinked marginal revenue curve: pre−policy there are three market segments defined by the reimbursement rates patients offer. The leftmost downward sloping segment of the marginal revenue curve, MR^p, represents the private insurance market (highest reimbursement rate). The horizontal segment, $MR^{Medicaid}$, captures the Medicaid market. The uninsured (lowest reimbursement) market is represented by the rightmost downward sloping segment of the marginal revenue curve (MR^u). Pre−policy, Medicare patients are included in the uninsured market as their coverage does not include OTP care.

All else equal, OTPs prefer to treat patients that offer higher reimbursement rates. Patients will be treated in the following order (pre−policy): private/self−pay, Medicaid, and uninsured (which includes Medicare). OTP i will only treat patients within group j if $MR^j \geq MC^i$; where $j \in \{private\,insurance\,or\;self pay,\; Medicaid,\; uninsured\}$. The mix of markets in which an OTP participates is determined by its marginal cost curve: OTPs treat all patients up to the point where $MC^i = MC^j$. In Figure 2 (relatively high marginal cost) OTP's with MC^1 will only treat (relatively high reimbursement rate) privately insured patients. OTPs with marginal cost curves MC^2 and MC^3 will treat privately insured and Medicaid covered patients. Relatively low marginal cost OTPs, such as those with MC^4, will treat patients in all three markets.

The Medicare policy change can be depicted with the new market segment $MR^{Medicare}$ reflected by the horizontal line left of $MR^{Medicaid}$ (i.e., higher reimbursement). The uninsured market will decline in size (i.e., Medicare beneficiaries are now insured for OTP care). Assuming no crowd−out, this shift will be one−for−one in terms of the number of new members of $MR^{Medicare}$ for each member of MR^u that leaves this market. The uninsured portion of the marginal revenue curve (MR^u) rotates inward. There is no change in the size of the private (MR^p) or the Medicaid ($MR^{Medicaid}$) market.[14] This change implies that a larger share of patients overall has coverage for OTP treatment.[15]

This policy change will impact OTP's mix of patients served and the quantity of

[12] See footnote 7 for Medicare and private OUD methadone treatment reimbursement rates.

[13] Self−paying patients may be more appropriately allocated to the private market as studies show that self−financing patients may pay more than any other group (Tompkins et al., 2006; Anderson, 2007). Here we combine self−paying and private insurance patients. In the analysis, we separately consider private, self−pay, and uninsured markets along with Medicare and Medicaid/other public coverage.

[14] We abstract from dual eligibles here. Because Medicaid is the 'last' payer, the Medicaid market may shrink as most states cover methadone for OUD (see footnote 11 for details). Dual eligibles will use Medicare to pay for this care post−policy while pre−policy they rely on Medicaid.

[15] Demand theory predicts that gaining insurance increases the quantity of OTP treatment demanded by reducing the out−of−pocket price (Grossman, 1972), we focus on changes in market size.

treatment provided. The impacts will be heterogeneous across OTPs based on marginal cost curves. (We assume the policy does not change marginal cost curves given our short post−period.) OTPs with (relatively high) marginal cost curve MC^1 treating privately insured patients only pre−policy will continue to participate in the private market only and will not change the quantity of treatment delivered. The newly covered Medicare beneficiaries offer a reimbursement rate that is below the level accepted by these OTPs ($MR^{Medicare} < MR^p$) thus there is no change. OTPs with MC^2 participate in the private and the Medicaid market pre−policy. Post−policy, these OTPs continue to participate in the private market, enter the Medicare market, but may exit the Medicaid market as newly covered Medicare patients offer a higher reimbursement rate than Medicaid. Treatment delivered increases from Q^2 to $Q^{2'}$. OTPs with MC^3 enter the Medicare market and continue to participate in the Medicaid market, and experience no change in the quantity of treatment provided. The lowest marginal cost OTPs (MC^4) continue to participate in all markets, but provide less treatment.

Our framework leads to hypotheses which we will test empirically. Post−policy:

Hypothesis 1 *More OTPs will participate in the Medicare market.*

Hypothesis 2 *Fewer OTPs will participate in the Medicaid market.*

Hypothesis 3 *Fewer OTPs will participate in the uninsured market.*

Hypothesis 4 *No change in the number of OTPs participating in the private market.*

Hypothesis 5 *The quantity of treatment delivered may increase or decrease depending on the relative changes in treatment provided by OTPs with MC^2 and MC^4.*

Spillovers may lead to departures from Sloan model predictions. In particular, OTPs could increase participation in other insurance markets after the policy change. Such changes could occur if the policy induces an OTP, that earlier did not accept any insurance, to accept Medicare, and there could be positive spillovers from such participation (e.g., hiring billing personnel and purchasing billing technology) that leads to the marginal cost of billing other insurance to decline, and a corresponding increase in participation in such markets (e.g., Medicaid, private).

The Sloan model is silent on provision of charity care, that is care that SUDTFs provide for free or at a heavy discount. This type of financing is provided by 50% of SUDTFs in our sample (see Table 3.4). However, Chen (2014) shows that public policies which expand coverage or change reimbursement rates can have ambiguous impacts

on provision of charity care as they induce conflicting income and substitution effects. Neither Sloan et al. (1978) nor Chen (2014) provide predictions on treatment intensity. Models of provider−induced−demand (McGuire, 2000) offer suggestive evidence that there is more scope for demand inducement post−policy when there are more high MR OTP patients in the market. There could also be 'mechanical' spillovers with OTPs beginning to offer services reimbursed by Medicare post−policy (Frank et al., 2003). We will test for changes in treatment intensity using offered services as proxies.

3 Data and methods

3.1 Opioid treatment program data

SUDTF data for this study are drawn primarily from the Mental Health and Addiction Treatment Tracking Repository ('MATTR') 2015−2021. MATTR include information scraped from SAMHSA's annual National Directory of Drug and Alcohol Abuse Treatment Facilities. The data include licensed U.S. SUDTFs that respond to the National Survey of Substance Abuse Treatment treatment (N−SSATS) 2015−2020 and the National Substance Use and Mental Health treatment Survey (N−SUMHSS) in 2021 (Substance Abuse and Mental Health Services Administration, 2022b). The data capture a 'snap shot' of SUDTF operations in March of each year. A SUDTF must meet one of three requirements to be eligible for inclusion in the N−SSATS or N−SUMHSS: i) approved, accredited, or licensed to provide SUDT; ii) staff have specialized credentials to provide SUDT; or iii) authorized to bill a third−party payer for SUDT (Substance Abuse and Mental Health Services Administration, 2022a).

MATTR include information on forms of payment accepted, whether the SUDTF is an OTP, and whether the SUDTF offers MOUD. We assign a SUDTF as an OTP if the facility reports being an OTP on the survey in 2019, though we show that our results are not sensitive to requiring that the SUDTF reports being an OTP in the survey each year 2015−2019 (i.e., pre−period) or all years of the study period (2015−2021). We limit our analysis to SUDTFs that respond to the survey and are in the directories for all study years (N=6,726). Our focus on the balanced panel of facilities leads us to exclude 13,689 facilities that ever responded to the survey 2015−2021. MATTR are the only longitudinal source of information on SUDTF location, acceptance of payment forms, provision of charity care, ownership, and offered treatment in the U.S., all of which are necessary for our study. A limitation of using MATTR is, like all databases of SUDTFs of which we are aware, they do not capture the universe of such facilities.

3.2 Opioid treatment program episodes

MATTR do not include information about the quantities of treatment provided. To test quantity predictions from the Sloan model, we turn the Treatment Episode Dataset (TEDS) 2015−2021, which includes data on SUDT episodes reported to SAMHSA for the purpose of tracking SUDT in the U.S. They are an all−payer database of facility−based SUDT episodes in all states. TEDS include two million outpatient, residential, and hospital treatment episodes among persons 12 years and older annually, and client demographics and substances of use. States are required to report a 'minimum' set of information for publicly funded episodes, but many track a broader set of episodes (Substance Abuse and Mental Health Services Administration, ND). Our study excludes five states (Delaware, Idaho, Maryland, New Mexico, and Washington) which do not participate in TEDS in all seven years of our study.

We use information in TEDS to isolate treatment likely received in OTPs. We identify likely OTP treatment among older adults using a flag for MOUD treatment on the episode record and patient age (65 years+). TEDS include information on service setting and we retain only non−intensive outpatient treatment as this is the setting that is most likely to reflect OTP treatment. We examine episodes with MOUD listed on the treatment plan among those 65+ and opioids as a substance of use at admission.[16]

We expect much of the treatment we capture in TEDS to reflect methadone given that we focus on settings where methadone OUD is more likely than other MOUDs − buprenorphine and naltrexone are more frequently administered in outpatient settings − although we note that we cannot fully isolate methadone for OUD from other treatment forms. We expect that our inability to study only methadone will lead us to underestimate the effect of the 2020 policy change on methadone treatment episodes.

TEDS have other limitations. We cannot track patients or providers. Expected payer is missing for 58% of episodes which prevents us from studying the use of Medicare. Nonetheless, TEDS offer an opportunity to study service quantity which we cannot examine in MATTR; using MATTR and TEDS allows a more comprehensive analysis.

3.3 Methods

In order to isolate the impact of the 2020 Medicare policy from other contemporaneous influences, we use a difference−in−differences (DID) identification strategy. In our

[16]TEDS records information on up to three substances at intake. We include episodes for which heroin, non−prescription methadone, or other opiates and synthetics (buprenorphine, butorphanol, codeine, hydrocodone, hydromorphone, meperidine, morphine, opium, oxycodone, pentazocine, propoxyphene, tramadol, and other narcotic analgesics, opiates, or synthetics) are listed.

main analysis of the MATTR data, we compare trends in outcomes for OTPs (treatment group) and non−OTPs (comparison group) before and after the 2020 policy change.

Our primary regression specification is reported in Equation 1.

$$P_{i,t} = \beta_0 + \beta_1 Treat_i * Post_t + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{1}$$

Where $P_{i,t}$ is an outcome for SUDTF i in year t. $Treat_i$ is an indicator coded one if the SUDTF is an OTP and zero otherwise. $Post_t$ is an indicator coded one for years 2020−2021 and zero for years 2015−2019. The interaction between these two variables ($Treat_i * Post_t$) represents our DID variable. We include SUDTF (α_i) and year (γ_t) fixed−effects. $\epsilon_{i,t}$ is the error term which is clustered around the SUDTF. MATTR have no weights.[17] Profit status of the facility may influence response to changes in market structure (Maclean et al., 2018; Hamersma and Maclean, 2021). We estimate regressions for for−profit and non−profit − government ('non−profits') SUDTFs separately.

The key assumption that allows us to recover causal estimates of the average treatment on the treated (ATT) using DID methods is 'parallel trends.' That is, had the treatment group (OTPs) not received treatment, than the treatment and comparison (non−OTPs) groups would have followed the same trends in Medicare acceptance. The assumption is untestable as OTPs were treated by the 2020 policy change.[18] We follow the literature and estimate an 'event−study.' We decompose our DID variable into a series of year indicators interacted with the treatment group indicator. The event−study allows us to explore (by examining the policy 'leads') whether treatment and comparison SUDTFs followed similar trends in Medicare acceptance pre−2020 and to asses dynamics in treatment effects over time (by examining the policy 'lags'). We omit the 2019 policy lead. Otherwise the regression is identical to Equation 1.

We also report the violation of parallel trends that could explain the estimated effect following Rambachan and Roth (2023).[19] This procedure yields confidence intervals that are robust to violations of parallel trends equal to $\bar{M}$ times the size of the largest parallel trends violation observed in the pre−period. We compute robust confidence intervals for potential values of $\bar{M}$ in multiples of 0.5, and we report the smallest value of $\bar{M}$ that would yield a robust confidence interval that includes zero.

We cluster standard errors at the level of treatment assignment, which in this case is best argued as at the SUDTF−level, as a SUDTF is either treated or not. SUDTFs

[17] The `fixest` package is used for MATTR regressions (Bergé, 2018).

[18] Treatment occurs at one time period. Thus, our study is not subject to concerns about bias from heterogeneity and dynamics in treatment effects when using DID methods with a staggered policy roll−out (Goodman-Bacon, 2021).

[19] We use the `HonestDID` package (Rambachan and Roth, 2023; Rambachan, 2023).

do not choose the year of treatment; all treatment occurs in one year (2020) as often happens in a randomized control trial (RCT) setting. In RCT settings, as well as our own, the type of unit that receives treatment (OTP vs. non−OTP designation here, and treatment group vs. the control group in general) is recognized as not appropriate for clustering due to a need for a sufficient number of clusters for overcoming severe downward bias in standard errors (Cameron and Miller, 2015), and instead, standard errors are clustered at the unit level (de Chaisemartin and Ramirez-Cuellar, 2020).

In our analysis of treatment quantity effects using TEDS, we alter our regression due to differences across data sets and the distribution of outcome variables. Our treatment and comparison groups are episodes where MOUD is reported and not reported in the treatment plan, and the analysis is conducted at the state−treatment−level. We include a fixed−effect for the treatment group and state fixed−effects, cluster standard errors by state, and weight the data by the state Medicare population (Centers for Medicare & Medicare Services, 2023). We use a Poisson regression given the count−like nature of episodes, using the state Medicare population as the exposure variable.[20] We convert Poisson coefficient estimates to average marginal effects.

3.4 Summary statistics and trends

Table 1 reports summary statistics for the treatment and comparison group in 2019. 14% of SUDTFs are OTPs, 14% offer methadone,[21] and 39% offer buprenorphine. 38% accept Medicare, 73% accept private insurance, 80% accept other state or federal insurance plans (e.g., military or federal employee coverage) or receive state funding, 72% accept Medicaid, and 91% accept self−paying patients. These shares line up with Sloan model predictions in that SUDTFs are more likely to accept higher reimbursement payment forms. 50% of SUDTFs use a sliding fee scale or offer free care, which we refer to collectively as 'charity care.' The median number of healthcare treatment; screening, testing, and assessment ('screening') treatment; mental health treatment;[22] and wraparound treatment offered by SUDTFs are six, six, two, and 12.

As observed in previous studies (Maclean and Saloner, 2018; Hamersma and Maclean, 2021), there are differences in SUDTFs by ownership status (Table 1). For example, a greater share of for−profits than non−profits are OTPs: 26% vs. 7.8%. For−profits are more likely to accept the highest reimbursement rate patients (self−pay) than are

[20] The `ppmlhdfe` package is used for all TEDS regressions (Correia et al., 2019).

[21] 90% of SUDTFs that report being an OTP offer methadone and 96% of SUDTFs that report offering methadone report that being an OTP.

[22] Mental health treatment is important given the substantial level of co−morbidity of OUD and mental health disorders (National Institutes of Health, 2022).

non-profits: 97% vs. 88%, but are less likely to offer charity care (30% vs. 60%).

Table A1 reports characteristics of SUDTFs in the MATTR data excluded and included in our analysis sample. Included SUDTFs are more likely to be non−profits and OTPs than are excluded SUDTFs. Excluded and included SUDTFs are similar in terms of accepted payments and offered treatment, although included SUDTFs are more likely to provide charity care than are excluded SUDTFs. 12% of excluded SUDTFs do not report ownership status. Overall, the two groups of SUDTFs are relatively similar, which might suggest that selection into the analysis sample is not substantial.

OTPs are not likely to have accepted Medicare prior to the 2020 policy change as Medicare did not cover methadone for OUD treatment which is the primary service offered by OTPs. Yet, we observe some OTPs in our analysis sample that report Medicare acceptance prior to 2020. One possibility is that some OTPs may have accepted this insurance form for Medicare reimbursable treatment in pre−2020 unrelated to methadone. Respondents to the N−SSATS may be referring to other treatment at their facility that could be reimbursed by Medicare, or that in general (albeit not for dispensing methadone) providers at the OTP accept Medicare. In Table A2 we report service offerings (and other variables used in our analysis) of OTPs that accept Medicare in each year pre−2020. During this time period, OTPs offered four to five general healthcare services, six to seven screening services, and 13 to 15 wraparound services. Some of these services could have been reimbursed by Medicare, leading to Medicare acceptance pre−2020. Another possibility is reporting error. The person completing these surveys is supposed to be a knowledgeable employee, but reporting error is possible. Maclean and Saloner (2018) note this possibility in a study of the Massachusetts healthcare reform using N−SSATS and this phenomenon is observed in surveys where respondents mis−report coverage (Lo Sasso and Buchmueller, 2004). In our main analysis, we include SUDTFs (OTPs and non−OTPs) that report and do not report Medicare acceptance prior to 2020, but we show in robustness checking that our results are not sensitive to excluding OTPs that report Medicare acceptance prior to the policy change (Section 5).

The policy change could have prompted some non−OTPs to enter the OTP market. Such behaviors could lead to compositional shift in the population of OTPs, potentially leading to bias in our coefficient estimates.[23] However, Figure A1 shows that the number of OTPs is stable over our study period and, of particular importance, there is no observable change in 2020. This figure also shows trends among for−profits and non−profits,

[23]Some readers may view increases in the number of OTPs as part of the policy effect. If the policy change induces some OTPs to enter the market and those OTPs are different from incumbent OTPs in the forms of payment they accept or their provision of care, then our findings will reflect the impact of the policy on incumbent faculties and a change in the composition of OTPs.

again there is no observable spike in 2020. We have also examined trends in the unbalanced sample (Figure A2). Here we report the share OTP in both samples, again there is no observable spike in 2020.[24] There are substantial barriers to becoming an OTP (Section 2) which, in the short−run that we consider, likely prevent substantial entrance into the OTP market.[25] We take these findings as evidence that the 2020 policy did not alter the number or composition of OTPs. Figure A3 shows the geographic distribution of OTPs and non-OTP SUDTFs across counties in 2019, just before the policy change.

Trends in Medicare acceptance by OTPs are reported in Figure 3. The trend analysis foreshadows our main finding: in 2020 the share of OTPs accepting Medicare increased sharply. Among all OTPs, over the period 2015 to 2019 21% to 26% accepted Medicare and in 2020 and 2021 the shares are 62% and 80%. The increase in Medicare is particularly pronounced among for−profits: in 2019 14% accepted Medicare, and the rate increased to 58% in 2020 and 79% in 2021. These trends suggest that OTPs, especially for−profits, quickly and aggressively responded to the policy change. Given that Medicare represents a large share of the U.S. population, the U.S. population is aging and those with OUD are living longer than earlier cohorts, and Medicare offers relatively high reimbursement rates, this surge in acceptance is not surprising.

Figure 4 reports trends in the number of OTP and non−OTP episodes among elderly adults in TEDS. Trends for the two groups move in parallel prior to 2020, although there may be an uptick in OTP episodes in 2018, which could be attributable to federal policies aimed at increasing capacity within the OUD treatment delivery system (Congressional Budget Office, 2022). Excluding 2018 does not alter findings (Section 4).

We use the 2021 National Survey on Drug Use and Health (NSDUH) to examine characteristics of older adults with OUD or that use opioids non−medically. NSDUH are used to provide the official U.S. behavioral health statistics. Table A3 reports characteristics of adults 65 years and older; we stratify the sample by past−year non−medical opioid use.[26] 2.0% report past−year non−medical opioid use. Older adults with past−year non−medical opioid use are less advantaged than comparable adults without such use in terms of observable characteristics. For example, 23% of older adults with past−year non−medical opioid use received public assistance and only 42% reported very good or excellent health vs. 16% and 68% among older adults without such use. Among older adults reporting past−year non−medical opioid use, 25% used tobacco products, 5.5% received any SUD treatment, and 2.1% received any MOUD treatment.

[24]There are caveats to this analysis. The number of SUDTFs reporting data to SAMHSA changes each year. These changes complicate interpretation of time trends as the sample changes year−to−year.

[25]There is no obvious incentive for the policy to induce OTPs to exit the market.

[26]OUD may be under−diagnosed in survey settings, so we focus on non−medical use.

4 Results

4.1 Medicare acceptance

Medicare acceptance event−study results are reported in Figure 5 and Table A4. We report results overall and by ownership status. The event−study results suggest that OTPs and non−OTP SUDTFs followed similar trends in the probability of Medicare acceptance pre−policy: coefficient estimates on the lead variables are small in size and statistically indistinguishable from zero. Precisely in the policy change year (2020), there was a sharp increase in Medicare acceptance among OTPs, that increase continued to grow into 2021. Results are similar for for−profit and non−profit SUDTFs.[27]

Table 2 reports our main DID regression results. OTP acceptance of Medicare post−2020 (relative to other SUDTFs) increased by 41.4 percentage points ('ppts') which implies a 167% increase relative to the pre−2020 OTP mean acceptance rate (24.8%). This large effect size, a near doubling of the Medicare acceptance rate, is in line with unadjusted time trends reported in Figure 3.

Another source of data that can offer additional verification on the finding we observe in MATTR that OTP participation in Medicare increased sharply post−2020 is administrative data between 2019 and 2022 from the Centers for Medicare & Medicaid Services (CMS) on OTPs enrolled in Medicare (Centers for Medicare & Medicaid Services, 2023).[28] We report trends in the number of OTPs newly enrolled with CMS to be reimbursed by Medicare for OTP treatment by year in Figure A4. These administrative data corroborate our findings using MATTR. In 2019, 2020, 2021, and 2023, the number of OTPs newly registered with CMS was one; 1,229; 115; and 60. This trend analysis demonstrates the remarkably sharp response to the Medicare policy by OTPs.

Examining effects by SUDTF ownership status in the MATTR again demonstrates that for−profit OTPs are particularly nimble in responding to incentives as measured by changes in market structure. Among for−profits, the probability of accepting Medicare increased 53.2 ppts or over four−fold. Non−profit OTPs also respond to Medicare coverage for methadone: acceptance of this payment form increased by 24.2 ppts (53.9%).

Our main coefficient estimate is robust to a violation of up to eight times the largest coefficient estimate in the pre−treatment period (i.e., the largest observed violation) for the full sample of SUDTFs. The breakdown value in the for−profit sample is 10.5 and

[27] An exception is that the 2017 lead coefficient estimate in the for−profit regression is statistically different from zero. We are uncertain as to why we observe this finding. However, as we report later in this section, our coefficient estimate in the for−profit sample is robust to violation of 10.5 times the size of the largest coefficient estimate in the pre−treatment period.

[28] We are able to match 96% of providers in MATTR to the CMS data.

the break−down value in the non−profit sample is three.

We note that the policy change could lead some patients to substitute away from previously covered MOUDs and toward methadone for OUD. We are not able to explore this possibility in our data. However, descriptive evidence using claims data from Taylor et al. (2023) does not suggest that such substitution occurred, at least in the short−run. In Section 4.5, we will explore the impact of the policy on an OTP's propensity to offer buprenorphine, which may capture some dimensions of substitution.

4.2 Heterogeneity

In Table 3, we report heterogeneity based on pre−2020 characteristics to assess whether the policy had differential impacts across OTPs. We focus on all SUDTFs in our anlaysis sample for brevity.

First, we stratify the sample by buprenorphine availability which we proxy by the number of healthcare professionals waivered to prescribe buprenorphine per capita in the county; we examine OTPs in counties at and at or below the 2019 median value. Pre−policy, Medicare acceptance at OTPs located in counties with high buprenorphine availability (i.e., above the median) was 27.6% and the acceptance rate was 7.1% among OTPs in counties at or below the national median value. OTPs in both types of counties increased the probability that they accept Medicare post−policy. The absolute effect size is similar (40.9 ppts in counties above the median and 44.6 ppts for counties at or below the median), the relative effect size is quite different: 148% among OTPs in counties above the median and 628% among OTPs in counties at or below the median. While ex ante, one might expect the opposite pattern of results, that is OTPs respond more aggressively where there are fewer treatment options for patients, access to buprenorphine may reflect underlying need for OUD, Medicare concentration, or capacity within the local healthcare market to accept Medicare and therefore absorb demand for treatment by the newly covered beneficiaries. On the other hand, the areas most receptive to MOUD generally also had better access to buprenorphine prior to 2020. Harris et al. (2023) show that counties with a Medicare−accepting SUDTF offering MOUD prior to the 2020 policy change were more likely to have an OTP accepting Medicare in 2021 (the year after the policy change we study), which is in line with our finding.

We proxy the importance of Medicare in the local healthcare market for OTP treatment using the number of beneficiaries per OTP in the county in 2019. We stratify the sample into counties above the median and at or below the median. In 2019, the rate of Medicare acceptance varies substantially across these two groups: in counties above the

median 28.5% accepted Medicare while the rate was 18.2% in counties at or below the median. OTPs located in markets with high numbers of Medicare beneficiaries increased acceptance of this payment form by 37.8 ppts (133%) while OTPs with in markets with low numbers increased acceptance by 46.3 ppts (254%). Ex ante, we might expect that counties in which Medicare is relatively more important, the effect of the 2020 policy change may have been more pronounced, but that is not what these findings imply. One possible reason for the effects we observe is that counties with lower Medicare beneficiaries per OTP may have had less access to OUD treatment for those covered by Medicare generally, and therefore the gains to any OUD treatment were more substantial. Similarly, when we stratify the sample into groups of states above and below the median OUD inpatient episodes in 2019, using data from the Healthcare Cost and Utilization Project FastStats, per Medicare beneficiary (this metric incorporates need for treatment within the local Medicare population) among those aged 65+ (results not shown, but available on request) we estimate effects to be larger among those below the median (42.8 ppts, a 264% increase) compared to those above the median (36.8 ppts, a 101% increase). These findings corroborate results based on the overall Medicare population.

SUDTFs are less likely to accept insurance than general healthcare providers (Buck, 2011). OTPs that did not accept any insurance forms pre−2020 might be expected to face particularly large barriers to accepting Medicare. To test for such differences, we stratify the sample based on whether the OTP accepted any insurance in 2019. (The mean Medicare acceptance share is non−zero for both samples as the statistic is calculated over all pre−policy years.) Both groups of OTPs experienced a large increase in the probability of accepting Medicare following the policy change: 42.8 ppts and 27.7 ppts among OTPs that accepted any insurance in 2019 and those that accepted no insurance.

Finally, we test heterogeneity based on financial protection for time away from work for healthcare, which may shape local demand for treatment. As a proxy for this factor, we stratify the sample based on whether the OTP operated in a state that mandated employers to provide paid sick leave (PSL) to employees as of 2019.[29] These mandates confer, on average, seven days of paid leave each year. Employees can use these days to attend to their own health needs or needs of their dependents, and can use partial days. PSL may facilitate patients (where the employee gaining access may be a person 65+ or a dependent) in receiving methadone treatment.[30] Previous research has established

[29]We use data from the National Partnership for Women and Families (2022)

[30]Seven days of PSL translate into 56 hours. Receiving a weekly dose of methadone from an OTP takes approximately 30 minutes, thus 56 hours translates into 112 methadone appointments per year. Patients who are able to take methadone home will require fewer visits and less time to receive treatment. Thus, the amount of time made available through PSL mandates allows for meaningful paid time for

that individuals with SUD are less likely to have PSL, and opioid−related overdoses were higher for individuals in Massachusetts that lacked PSL (Hawkins et al., 2019; Acevedo et al., 2022). Effects are large for both groups: in states with a PSL mandate in 2019 Medicare acceptance increased by 39.1 ppts and 45.1 ppts in other states.

4.3 Treatment quantity

We test quantity effects in TEDS using the number of episodes among patients age 65+ and with OUD listed on the treatment record. Here, we focus on non−intensive outpatient episodes, our treatment group includes episodes with MOUD listed on the record and our comparison group includes episodes without MOUD listed.

Table 4 Panel A and Figure 6 report an event−study for treatment episodes among older adults. We do not observe evidence of differential pre−trends.

DID results are reported in Panel B of Table 4. We observe that post−policy, the number of episodes increased by 37 relative to a baseline mean for likely OTPs of 157, which implies an increase of 23.6%. These results are robust to a violation of pre−trends equal to 0.5 times the largest coefficient estimate observed on any policy lead. Figure 4 demonstrates an increase in OTP episodes in 2018, excluding that year leads to very similar findings: the coefficient estimate is 36 (SE = 14).

Next, we stratify OUD episodes based on whether the patient had any prior treatment (Table 5). Segmenting the sample in this manner allows us to explore whether the reform increased episodes among treatment 'naive' (no prior treatment) or 'experienced' (at least one episode of treatment in the past) patients. Our findings suggest that both naive and experienced patients saw an increase in admissions, but the relative effect size is larger among experienced patients: 15.6% for naive and 32.1% for experienced.

In Table 6, we use alternative definitions of methadone for OUD treatment among those 65 years+. In column (1), we replicate results using our primary proxy for OUD−related methadone treatment. In columns (2) and (3), we define OUD−related treatment in both non−intensive outpatient settings and intensive outpatient settings, and non−intensive outpatient settings including only episodes where an opioid is the first substance reported on the treatment record. Results are similar. As a falsification test, in column (4), we use treatment episodes other than outpatient settings (detoxification, residential, and hospital). We observe no change in such episodes.

An important question to ask is whether the Medicare policy change improved patient outcomes. Neither the MATTR nor TEDS data provide information to address this

either patients to obtain methadone or their family members to assist them in obtaining the medication.

question. We turn to the TEDS−discharge ('TEDS−D') 2015−2021. TEDS−D includes the reason for a discharge, we use this information to construct the number of discharges for 'treatment completed' for patients 65+ with an opioid listed on the record. We view treatment completed as a proxy for the patient successfully completing treatment (other possible discharge reasons include death, incarceration, treatment terminated by the facility, transfer to another facility, and dropped out). Using this outcome, we estimate the same regression we employed in our analyses of the TEDS (Table 7). We find suggestive evidence that the number of successful treatment completions increased by 36.3% post−policy, but the coefficient estimate is only statistically different from zero at the 10% level. Future work could re−visit this question with more post−policy data.

4.4 Other accepted forms of payment and charity care

We test the impact of the Medicare coverage policy on acceptance of private insurance, Medicaid, other insurance (e.g., military and non−Medicaid state financed), and self−pay, and the provision of charity care (i.e., use of a sliding fee scale or free care for all patients). We report results overall and by ownership status in Tables 8 and 9.

The probability that an OTP accepts private insurance increased by 8.3 ppts (14.5%), with effects driven by for−profit OTPs. Medicaid acceptance probability increased by 7.0 ppts (10.1%), with heterogeneous effects by ownership status. For−profit OTPs increased acceptance of Medicaid by 13.9 ppts (24.5%) post−policy while non−profits decreased acceptance by 4.8 ppts (5.3%). There was no change in the probability of self−pay acceptance among OTPs overall or among non−profit OTPs following the policy change, but for−profit OTPs reduced the probability of self−pay acceptance by 2.6 ppts (2.7%). Acceptance of other insurance (e.g., military coverage) increased by 6.1 ppts (9.8%) for all OTPs and this change was driven entirely by for−profits which increased acceptance by 8.9 ppts (19.6%), there was no observable change in acceptance of other coverage among non−profits. The probability that a for−profit OTP accepted self−payments declined following the 2020 policy change by 2.6 ppts (2.7%). There was no observable change in the probability of accepting self−pay among OTPs overall or non−profit OTPs. We suspect that the finding among for−profits could reflect Medicare patients at these facilities shifted from self−pay to using Medicare payment. In terms of charity care provision, only for−profits appear to have responded to the policy change: for−profits increased the probability of providing charity care by 5.8 ppts (29.1%).

Results for accepted payment forms and provision of charity care are robust to violations of pre−trends 0.5 to 1.0 times as large as observed in the pre−treatment period

(see the final column in Tables 8 and 9. These findings are in line with evidence from event−studies (available on request) that display some evidence of differential pre−trends across OTPs and non−OTPs. We interpret these results with caution.

4.5 Treatment offered

We examine whether the 2020 policy change induced OTPs to vary their treatment offerings. We consider whether OTPs offer any of each of the following types of treatment: buprenorphine, general medical, screening, wrap around, and mental healthcare. Some variables are not included in MATTR until 2016. Results are reported in Table 10.

OTPs altered treatment post−policy along the extensive margin (i.e., any service offering). In the full sample, we observe declines in the probability that OTPs offer any general medical treatment by 5.8%, screening treatment by 5.6%, wraparound treatment by 4.2%, and mental health treatment by 6.6%. In particular, there is no evidence that the 2020 policy crowded out buprenorphine: there was no change in the probability that an OTP offered this MOUD. We lack the data to explore the mechanisms that lead to the observed changes in treatment, but OTPs may reduce overall treatment as they seek to meet the demand of newly covered Medicare patients.

Effects are similar among for−profit and non−profit SUDTFs, though one exception to this pattern of null results is that non−profits may have increased the probability of offering buprenorphine by 8.8% post−policy.

We note that our findings for treatment are potential vulnerable to a violation of the parallel trends assumption. In particular, these results are only robust to a violation of the pre−trend assumption as large as 0.5 to 1.5 times as large as the largest coefficient on policy leads we estimated in event−studies (results available on request) as reported in the final column of Table 10.

5 Robustness checks

In this section, we conduct a series of robustness checks to assess the extent to which our main Medicare acceptance findings might be sensitive to different samples, specifications, and approaches to statistical inference.

First, we use logistic regression instead of ordinary least squares and find similar results (Table A5). In Table A6, we explore the sensitivity of our results to different definitions of the treatment group. In our main analyses, we classify OTPs based on 2019 information available in the MATTR data. Next, we impose more restrictive defi-

nitions to classify OTPs: i) the SUDTF must report being an OTP in all pre−treatment years (2015−2019) and ii) the SUDTF must report being an OTP in all study years (2015−2021). Results are not sensitive to using any of these treatment groups.

The Medicare policy we study creates one treatment group (OTPs) and one comparison group (non−OTP SUDTFs). Thus, we have just two clusters and the correct approach to inference is not entirely clear, in Section 3.3, we motive our choice to cluster at the SUDTF−level. Here, we explore the sensitivity of using alternative approaches to inference, focusing on our main outcome (acceptance of Medicare) in the full sample (i.e., we do not stratify by ownership status). Results are reported in Table A7. We consider the following approaches: clustering standard errors by facility, state, and year; clustering standard errors by state and year; clustering standard errors by county and year; Huber−White robust standard errors; and cluster bootstrap. Overall, our results are not sensitive to these alternative approaches to inference.

Some OTPs reported Medicare acceptance prior to 2020, we suspect that this reporting pattern is potentially attributable to measurement error or the OTP being part of a larger healthcare center, with other parts of the center accepting Medicare for different services, rather than true acceptance of Medicare by a stand-alone OTP. Here, we stratify the sample based on whether or not the facility reported accepting Medicare in 2019 (Table A8). Pre−policy, acceptance rates of Medicare were 79.2% and 5.4% of OTPs that accepted this form of payment in 2019. Post−policy, the groups were less likely to discontinue accepting this form of payment (i.e., those that accepted in 2019) and were more likely to accept Medicare (i.e., those that did not accept in 2019). The changes in acceptance are 10.8 ppts and 52.6 ppts.

We exclude the year 2020 from the sample (Table A9). The COVID−19 pandemic changed healthcare use for many Americans, including the use of OUD treatment (Huskamp et al., 2020), suggesting that including this year in our study may impact findings. Results are robust to excluding 2020 however.

We drop each state and re−estimate Equation 1 to explore whether our findings are driven the experiences of specific states ('leave−one−out analysis'). Results are reported in Figure A5. The coefficient estimates are stable across the leave−one−out samples.

We next conduct a 'placebo' analysis. We use only pre−treatment data (2015−2019) and we sequentially treat years 2016, 2017, 2018, and 2019 as the false effective year and re−estimate Equation 1 with Medicare acceptance as the outcome (Table A10). We are unable to replicate our main findings in any placebo analysis.

To form an alternative panel of SUDTFs, we additionally used a looser inclusion criteria. Specifically, we included all SUDTFs that responded in survey year 2019 (when

OTP status was ascertained) and responded in any year 2020−2022. Results are reported in Table A11 and are similar to findings based on our main sample, suggesting that restricting to the balanced panel does not alter conclusions meaningfully.

Finally, ten state Medicaid programs did not cover methadone for OUD in 2018 and two did not in 2022 according to periodic surveys of state Medicaid programs conducted by Kaiser Family Foundation (ND). In these states, the OTP market departs from that depicted in our modified Sloan model (Section 2.2) and OTPs face a different patient choice set. We exclude the states not covering methadone for OUD in Medicaid in either of these surveys[31] and results (Table A11) are not appreciably different.

6 Discussion

In this study, we evaluate the effect of a 2020 policy change that, for the first time in U.S. history, allowed Medicare to reimburse for OUD−related methadone treatment. We use difference−in−differences methods and administrative data on OUD treatment to compare OTPs (the only settings in which methadone for OUD can be provided) before and after the policy, relative to other SUDTFs. Addiction experts predicted that this policy change would fundamentally enhance access to OUD treatment for many older Americans as other evidence−based treatment may be limited or methadone may be the most effective treatment for some patients.

Our findings suggest that the 2020 policy has the expected profound effect on the OUD treatment landscape in the U.S. However, the impacts are not as universal as policy makers might have intended, and impact a broader set of patients than those covered by Medicare. First, we show that OTPs are remarkably nimble in responding to a new source of funding: acceptance of Medicare surged by 41.4 percentage points following the policy change. While the effect size is large, this magnitude is reasonable and expected as Medicare covered 65.7 million beneficiaries in March 2023 (Centers for Medicare & Medicare Services, 2023), offers relatively high reimbursement for OUD−related methadone treatment, and older Americans make up an increasingly large share of population with OUD (Shoff et al., 2021). Moreover, our measure of market participation is arguably quite mild, that is we measure whether the OTP is willing to register with CMS in order to accept Medicare payments. Further, earlier evidence suggests that SUDTFs (both OTPs and non-OTPs) respond strongly to changes in insurance coverage. For example, Meinhofer and Witman (2018) show a 17% increase in the probability that an OTP

[31]States include Alaska, Idaho, Kansas, Kentucky, Louisiana, Nebraska, South Dakota, South Carolina, Tennessee, and Wyoming.

accepts Medicaid following ACA−related expansions of this program. Medicare covers a large and growing segment of the population with OUD and offers substantially higher reimbursement rates than Medicaid, thus one would expect a stronger response to the Medicare policy we study. Our results are encouraging by showing that OTPs are responsive to the 2020 policy in accepting Medicare as a form of payment. These findings are in line with a descriptive analysis of Medicare Advantage claims showing an increase in methadone dispensing post−2020 (Taylor et al., 2023).

Second, we show that treatment episodes among patients 65 years and older at OTPs increased by nearly 24% post−policy. Third, we observe no evidence that the expansion of Medicare coverage led OTPs to reduce participation i1n other markets. Indeed, we find some evidence of positive spillovers: post−policy, OTPs are more likely to participate in private, Medicaid, and other public insurance markets. When an OTP begins to accept Medicare, the facility must have billing procedures set−up to bill Medicare, thus these investments may spill−over to other insurance markets which would also require such procedures (e.g., electronic billing records). This hypothesis is consistent with our null finding for self−pay acceptance, which may require less technology for billing. Fourth, we observe an increase in the provision of charity care at OTPs post−policy. Theory predicts that insurance expansions have ex ante ambiguous impacts on this outcome as income and substitution effects off−set each other (Chen, 2014). Our findings suggest that the income effect dominates on average for OTPs. Fifth, non−methadone treatment offered by OTPs declined, which suggests that while Medicare enrollees may have better access to methadone for OUD, overall quality of care may have changed for all patients (both Medicare and other patients). However, as described in Section 4, some of our findings for non−Medicare payment forms, provision of charity care, and offered treatment may be vulnerable to bias from differential pre−trends. Using partial identification methods we show that these results are robust to violations 0.5 to 1.5 times as large as the most substantial estimated coefficient estimate in the pre−treatment period, but they are potentially not robust to larger violations.

Finally, we observe stark differences across non−profit and for−profit OTPs, suggesting that the effects of policies such as the 2020 Medicare increase in coverage may vary as the market for OTPs and SUDTFs becomes increasingly dominated by for−profits (Kodjak, 2016; Rayasam and Farmer, 2023). For example, for−profits are less likely to accept Medicare post−policy than non−profits and the increase in charity care provision overall is entirely driven by non−profits, for−profits reduce provision of charity care post-policy. Similarly, community characteristics appear to impact the extent to which OTPs respond to the policy change. Specifically, areas of the country with fewer

buprenorphine−waivered providers, and fewer Medicare beneficiaries experienced larger increases in Medicare acceptance by OTPs than their respective counterparts. Policymakers could consider tailoring future changes to incorporate these differing responses.

Our study is not without limitations. First, our data include a measure of whether an OTP accepts Medicare as a form of payment and we cannot not study the intensity with which a facility treats Medicare patients, which is an important outcome based on economic theories of provider behavior (Sloan et al., 1978). Second, we could not calculate trends in total capacity for OUD treatment: the number of treatment slots within facilities allocated to Medicare beneficiaries could have increased after the coverage change. Finally, we have limited information on patient outcomes in our data.

Given the immense toll the opioid crisis has taken on Americans, evaluating policies that promote treatment access and up−take is critical. While the healthcare industry played a pivotal role in the emergence and development of the opioid crisis, this sector is crucial to addressing underlying addiction that allows the crisis to continue (Maclean et al., 2021). A key limitation of early opioid policies (e.g., prescription drug monitoring programs) was a lack of integration of OUD treatment, instead focusing on curtailing opioid supply, accelerating substitution to illicit opioids (Alpert et al., 2018; Gupta et al., 2023; Mallatt, 2018; Kim, 2021; Powell and Pacula, 2021; Sacks et al., 2021). Our study, which evaluates the effects of a policy designed to promote access to OUD treatment, can have both positive and negative consequences, which is similar to earlier policies targeting the supply of opioids. A take−away of our work is OTP providers respond to incentives and this insight might provide guidance for additional policies.

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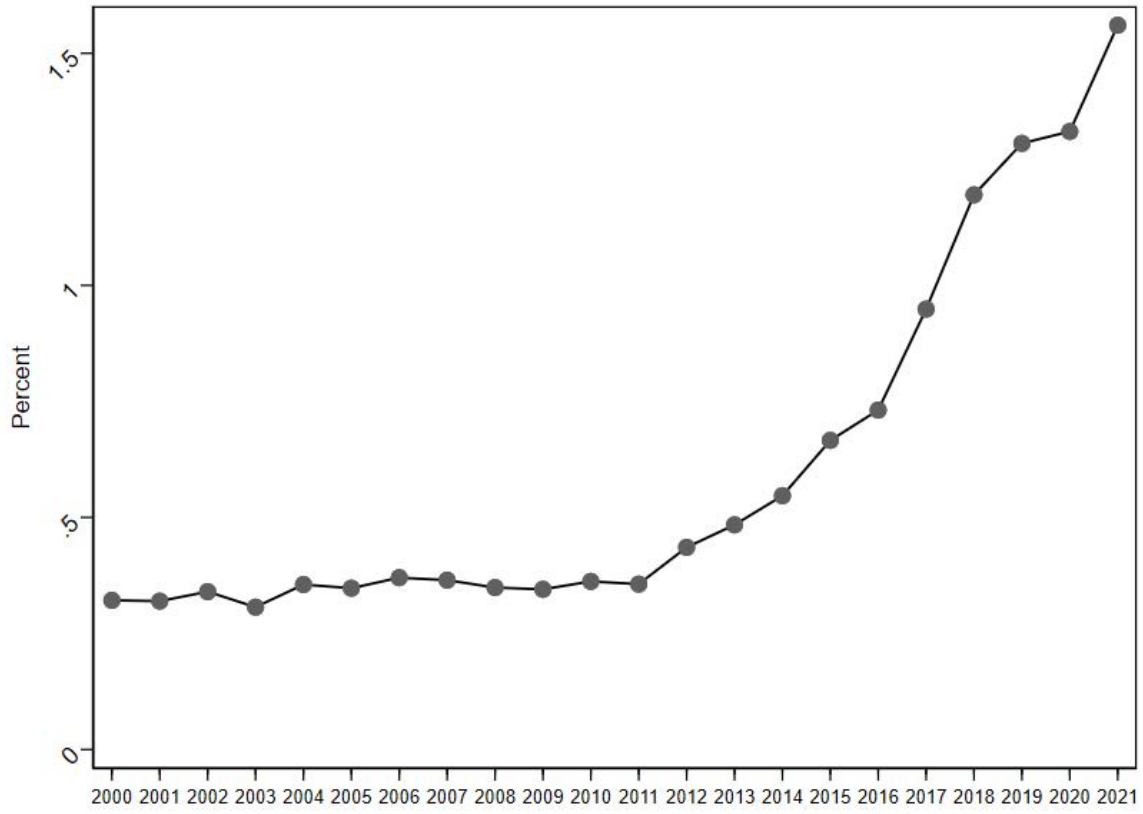
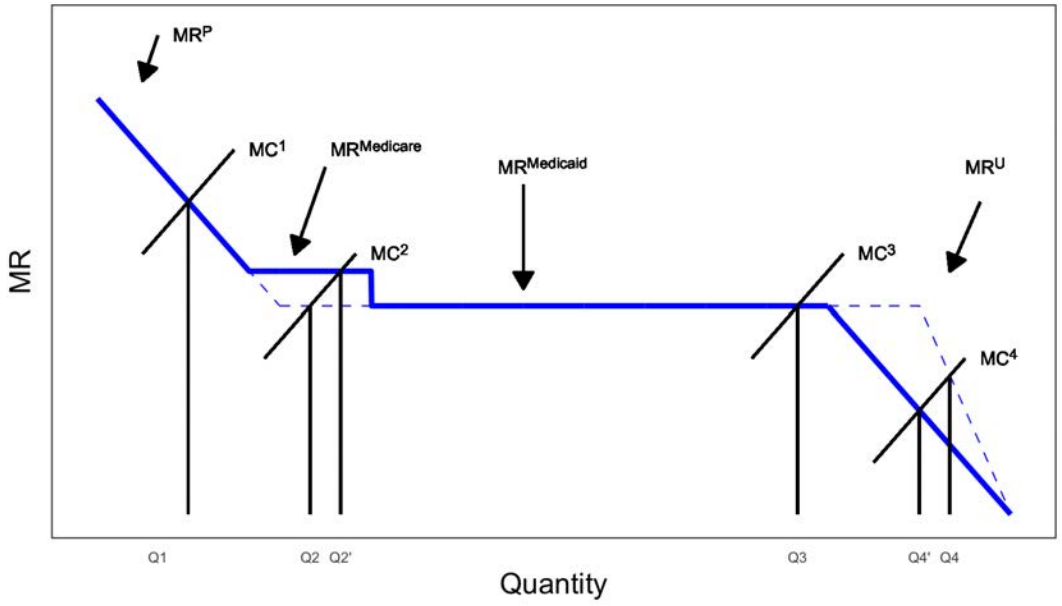
7 Figures and tables

Figure 1: Trends in the share of patients who are 65 years and older receiving treatment for opioid use: TEDS 2000−2021



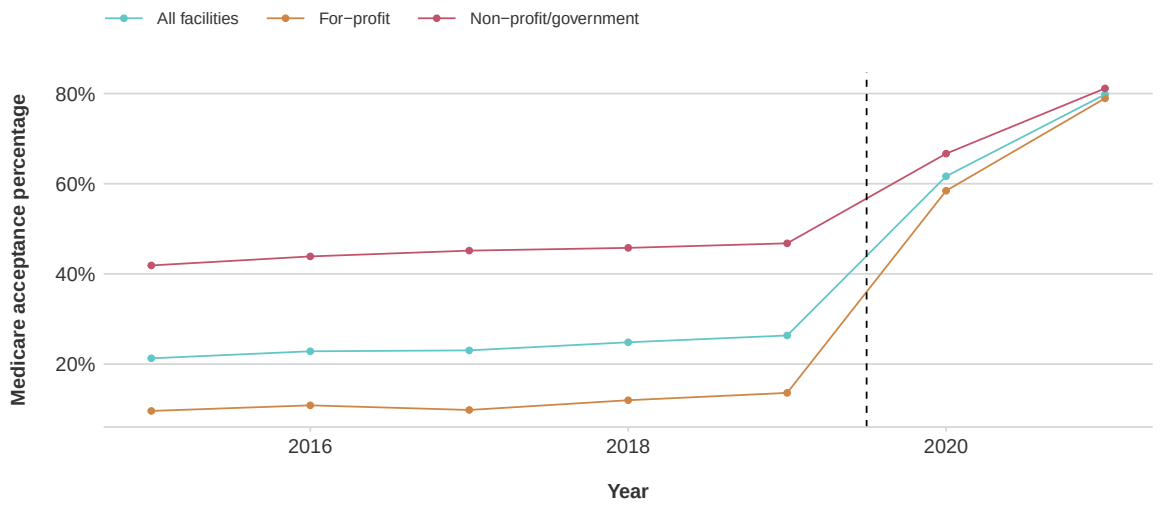
Notes: Data source is TEDS. Data are unweighted. Opioid use is defined based on opioid being listed at treatment episode intake.

Figure 2: Modified Sloan mixed−payer market



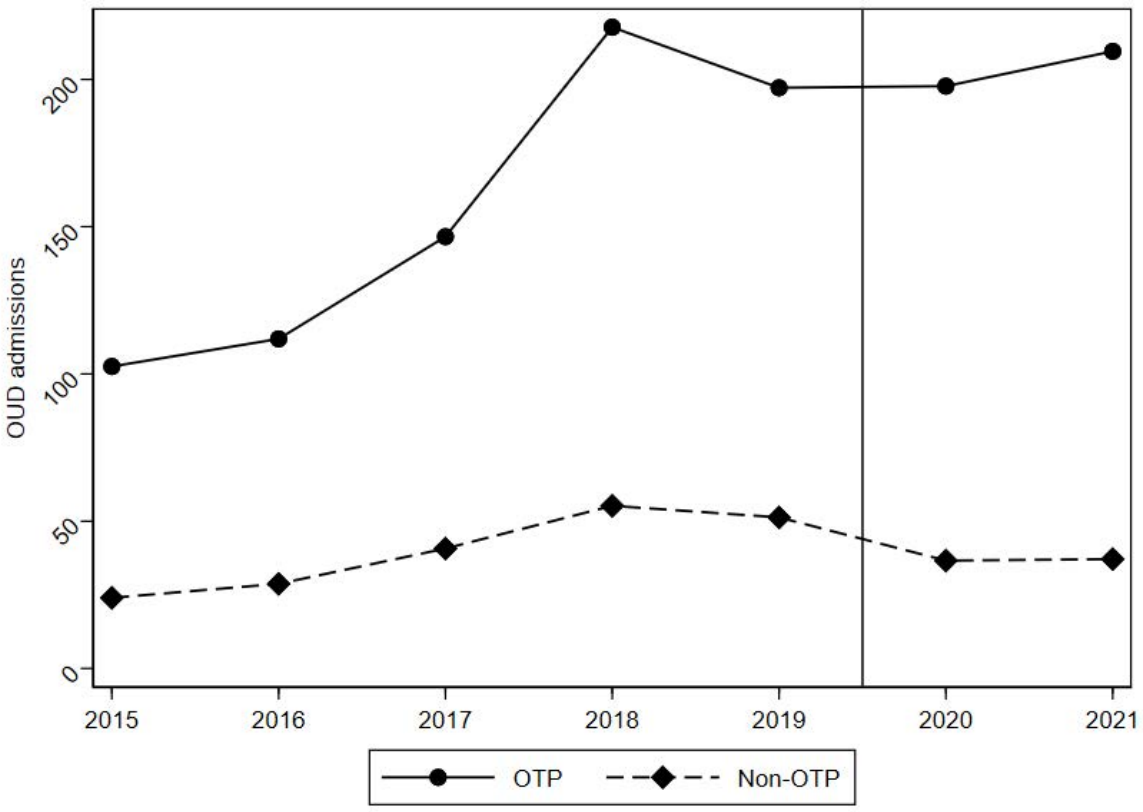
Notes: Figure is based on Sloan et al. (1978). MC=Marginal Cost, MR=Marginal Revenue. The combination of the solid and dashed blue lines reflect the marginal revenue curve in the OTP market prior to the 2020 policy change. The solid blue line demonstrates that introduction of Medicare coverage for OUD treatment for methadone in 2020. Prior to 2020, Medicare beneficiaries were uninsured for OTP treatment. Beginning in 2020, the policy change created a new market for OTP methadone treatment.

Figure 3: Percentage of OTPs that report accepting Medicare over time by ownership status: MATTR 2015−2021



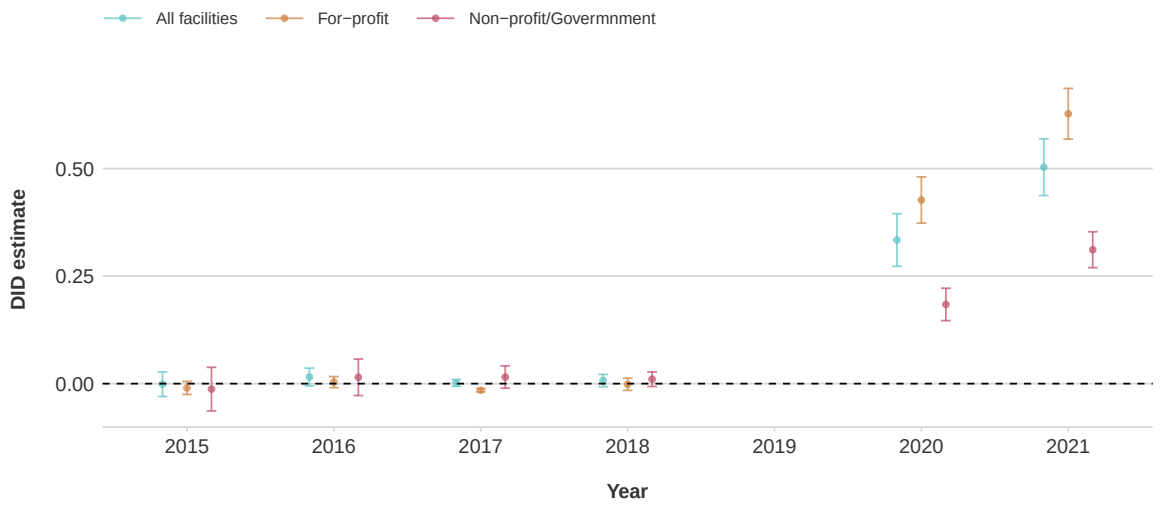
Notes: Data source is MATTR. Data are aggregated to the year−treat level. Data are unweighted.

Figure 4: Trends in the number of treatment episodes among adults 65 years and older: TEDS 2015−2021



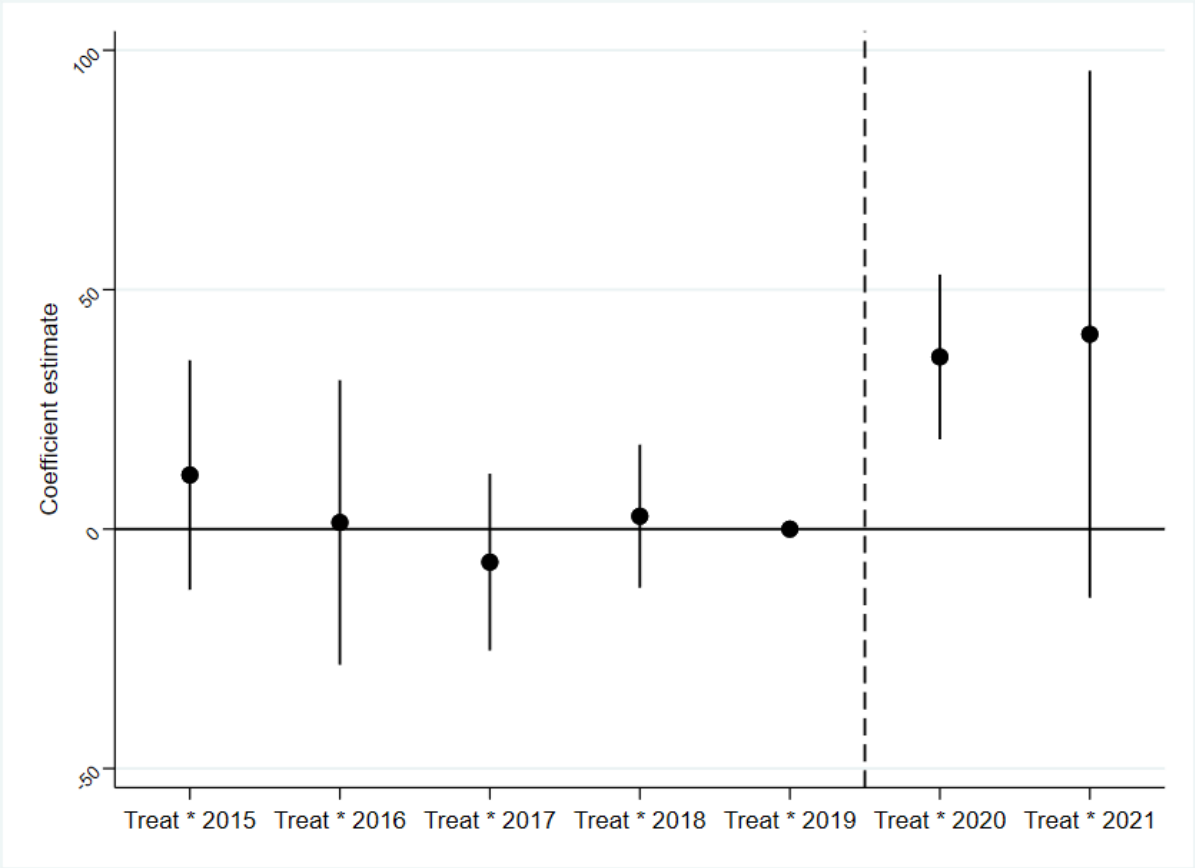
Notes: Data source is TEDS. Data are aggregated to the year−treat level. Data are weighted by the number of Medicare beneficiaries prior to aggregation.

Figure 5: Effect of the 2020 Medicare policy on acceptance of Medicare among all OTPs and by ownership status using an event−study: MATTR 2015−2021



Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. 2019 is the omitted year. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. 2019 is the omitted year. 95% confidence intervals that account for within−SUDTF clustering are reported with vertical lines. The number of observations is 6,726.

Figure 6: Effect of the 2020 Medicare policy change on OUD treatment episodes using an event−study: TEDS 2015−2021



Notes: Data source is TEDS. The regressions include an indicator for the treatment group (admission to an OTP), the number of Medicare beneficiaries in the state, state fixed−effects, and year fixed−effects. 2019 is the omitted year. The unit of observation is an an admission to an SUDTF in a state in a year. Data are weighted by the number of Medicare beneficiaries in the state. Regressions are estimated with OLS. 2019 is the omitted year. 95% confidence intervals that account for within−state clustering are reported with vertical lines. The number of observations is 616.

Table 1: Summary statistics for all SUDTFs in 2019: MATTR

Characteristic	Overall	For-profit	Non-profit
OTP	14%	26%	7.8%
Offer methadone	14%	26%	7.7%
Offer buprenorphine	39%	43%	38%
Accept Medicare	38%	22%	45%
Accept private insurance	73%	71%	74%
Accept other state insurance	80%	59%	90%
Accept Medicaid	72%	54%	80%
Accept any insurance	93%	85%	96%
Accept self−pay	91%	97%	88%
Charity care	50%	30%	60%
Healthcare treatment	6%	5%	6%
Screening treatment†	6%	5%	6%
Mental health treatment†	2%	2%	3%
Wraparound treatment†	12%	10%	13%
Observations	6,726	2,164	4,562

Notes: Data source is MATTR. Data are unweighted.
† = variable is not available in the 2015 MATTR.

Table 2: Effect of the 2020 Medicare policy on acceptance of Medicare among all OTPs, overall and by ownership status: MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
All facilities	0.248	0.414	0.016	<0.001	8
For−profit	0.123	0.532	0.019	<0.001	10.5
Non−profit	0.449	0.242	0.024	<0.001	3

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample. $\bar{M}$ = break−down value for parallel trend assumption violations.

Table 3: Heterogeneity by SUDTF characteristics in the effect of the 2020 Medicare policy on acceptance of Medicare: MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
Buprenorphine access					
> median	0.276	0.409	0.017	<0.001	7
≤ median	0.071	0.446	0.040	<0.001	5.5
Medicare beneficiaries					
> median	0.285	0.378	0.020	<0.001	6
≤ median	0.182	0.463	0.027	<0.001	10.5
OUD inpatient admission per 10,000 Medicare beneficiaries					
> median	0.364	0.368	0.025	<0.001	3.5
≤ median	0.162	0.428	0.023	<0.001	10
Any insurance acceptance in 2019					
Yes	0.279	0.428	0.017	<0.001	7.5
No (2019)	0.013	0.277	0.044	<0.001	6.5
PSL mandate 2019					
Yes	0.295	0.391	0.026	<0.001	3.5
No	0.178	0.451	0.021	<0.001	7.5

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. $\bar{M}$ = break−down value for parallel trend assumption violations.

Table 4: Effect of the 2020 Medicare policy change on OUD treatment episodes: TEDS 2015−2021

Outcome	OUD treatment episodes
Panel A: Event−study	
Treat × 2015	11
	(12)
Treat × 2016	1
	(15)
Treat × 2017	-7
	(9)
Treat × 2018	3
	(8)
Treat × 2019	−
	−
Treat × 2020	36***
	(9)
Treat × 2021	41
	(28)
Panel B : DID	
Treat × 2020−2021	37***
	(15)
Pre−period mean, treatment states	157
Observations	616
$\bar{M}$	0.5

Notes: Data source is TEDS. The regressions include an indicator for the treatment group (OUD treatment episode in an OTP), state fixed−effects, and year fixed−effects. In Panel A, 2019 is the omitted year in the event−study. The unit of observation is a treatment episode to an SUDTF in a state in a year. Data are weighted by the number of Medicare beneficiaries in the state. Regressions are estimated with a Possion regression, the number of Medicare beneficiaries in the state is the exposure variable. Coefficient estimates are converted to average marginal effects. Standard errors are clustered at the state level. $\bar{M}$ = break−down value for parallel trend assumption violations.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Table 5: Heterogeneity by prior treatment status in the effect of the 2020 Medicare policy change on OUD treatment episodes: TEDS 2015−2021

Outcome:	New patient episodes	Old patient episodes
Treat × 2020−2021	12**	25**
	(5)	(12)
Pre-treatment mean, treatment states	77	78
Observations	574	588

Notes: Data source is TEDS. The regressions include an indicator for the treatment group ((OUD treatment episode in an OTP), state fixed−effects, and year fixed−effects. The unit of observation is a treatment episode to an SUDTF in a state in a year. Data are weighted by the number of Medicare beneficiaries in the state. Regressions are estimated with a Possion regression, the number of Medicare beneficiaries in the state is the exposure variable. Coefficient estimates are converted to average marginal effects. Standard errors are clustered at the state level. $\bar{M}$ = break−down value for parallel trend assumption violations.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Table 6: Effect of the 2020 Medicare policy change on OUD treatment episodes using alternative definitions of OUD treatment: TEDS 2015−2021

Outcome	Non-intensive OP	All OP	Non-intensive OP, 1st substance	Non-OP
Treat × 2020−2021	37***	38***	35**	6
	(15)	(15)	(17)	(18)
Pre−treatment mean, treatment states	157	161	155	20
Observations	616	616	616	616

Notes: Data source is TEDS. The regressions include an indicator for the treatment group (admission to an OTP), state fixed−effects, and year fixed−effects. The unit of observation is an an admission to an SUDTF in a state in a year. Data are weighted by the number of Medicare beneficiaries in the state. Regressions are estimated with a Possion regression, the number of Medicare beneficiaries in the state is the exposure variable. Coefficient estimates are converted to average marginal effects. Standard errors are clustered at the state level.
OP = outpatient treatment. 1st substance = an opioid is the first of up to three substances listed on the treatment episode intake record.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Table 7: Effect of the 2020 Medicare policy change on successful discharges from to treatment using a Poisson model: TEDS−D 2015−2021

Outcome:	Successfully complete treatment
Treat × 2020−2021	4*
	(2)
Pre-treatment mean, treatment states	11
Observations	546

Notes: Data source is TEDS−D. Fewer states report data to TEDS−D than to TEDS, thus the TEDS−D sample size is smaller than that reported in Table 4. The regressions include an indicator for the treatment group (admission to an OTP), state fixed−effects, and year fixed−effects. The unit of observation is a treatment episode to an SUDTF in a state in a year. Data are weighted by the number of Medicare beneficiaries in the state. Regressions are estimated with a Possion regression, the number of Medicare beneficiaries in the state is the exposure variable. Coefficient estimates are converted to average marginal effects. Standard errors are clustered at the state level. $\bar{M}$ = break−down value for parallel trend assumption violations.
***,**,* = statistically different from zero at the 1%,5%,10% level.

Table 8: Effect of the 2020 Medicare policy change on the acceptance of private coverage, Medicaid coverage, and other public coverage, and self−pay, overall and by ownership status: MATTR 2015−2021

Sample	Outcome	Pre−treatment mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
All facilities	Private	0.573	0.083	0.011	<0.001	0.5
For−profit	Private	0.470	0.116	0.016	< 0.000	0.5
Non−profit	Private	0.739	0.016	0.015	0.307	0.5
All facilities	Medicaid	0.696	0.070	0.012	<0.001	0.5
For−profit	Medicaid	0.567	0.139	0.018	<0.001	0.5
Non−profit	Medicaid	0.904	-0.048	0.011	<0.001	1.0
All facilities	Other	0.623	0.061	0.011	0.000	0.5
For−profit	Other	0.454	0.089	0.018	<0.001	0.5
Non−profit	Other	0.894	-0.017	0.011	0.125	0.5
All facilities	Self-pay	0.961	-0.009	0.005	0.106	0.5
For−profit	Self-pay	0.980	-0.026	0.007	<0.001	0.5
Non−profit	Self-pay	0.931	-0.006	0.009	0.512	0.5

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample. $\bar{M}$ = break−down value for parallel trend assumption violations.

Table 9: Effect of the 2020 Medicare policy change on provision of charity care, overall and by ownership status: MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
All facilities	0.343	0.030	0.011	0.006	0.5
For−profit	0.199	0.058	0.014	<0.001	0.5
Non−profit	0.574	-0.010	0.019	0.601	1.0

Notes: Data source is MATTR. Charity care is defined as i) the use of sliding fee scale, ii) offering charity care, and iii) provision of free care. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample. $\bar{M}$ = break−down value for parallel trend assumption violations.

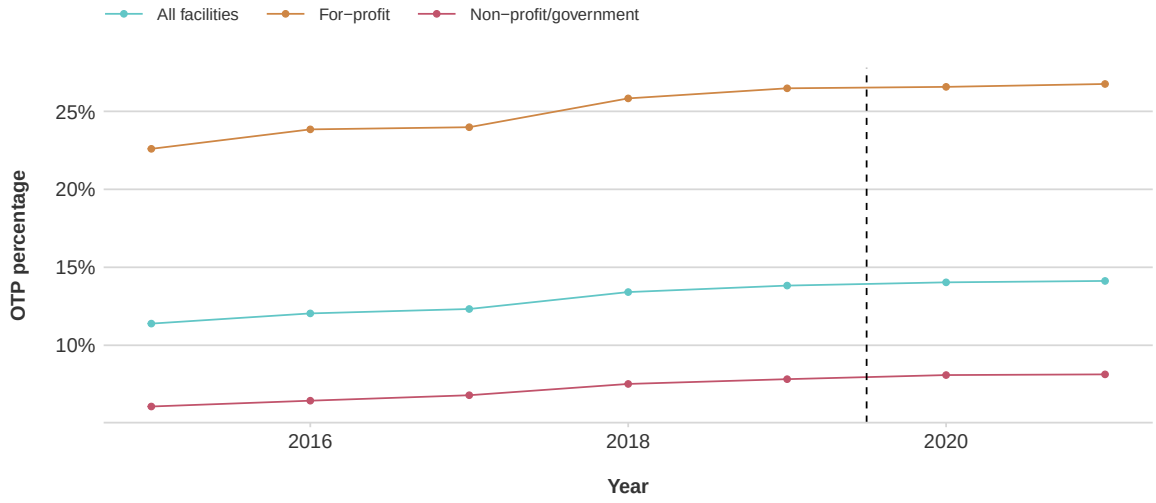
Table 10: Effect of the 2020 Medicare policy change types of treatment provided, overall and by ownership status: MATTR 2015−2021

Sample	Service	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
All facilities	Buprenorphine	0.648	0.0122	0.011	0.278	0.5
For−profit	Buprenorphine	0.640	0.056	0.278	<0.001	0.5
Non−profit	Buprenorphine	0.660	-0.015	0.016	0.346	0.5
All facilities	Healthcare	0.982	-0.047	0.004	<0.001	1.0
For−profit	Healthcare	0.978	-0.053	0.007	<0.001	1.0
Non−profit	Healthcare	0.988	-0.049	0.005	<0.001	1.0
All facilities	Screening	0.976	-0.051	0.005	<0.001	1.0
For−profit	Screening	0.977	-0.060	0.007	<0.001	1.0
Non−profit	Screening	0.976	-0.049	0.007	<0.001	0.5
All facilities	Wraparound	0.977	-0.049	0.004	<0.001	1.0
For−profit	Wraparound	0.977	-0.061	0.007	<0.001	1.0
Non−profit	Wraparound	0.977	-0.045	0.007	<0.001	0.5
All facilities	Mental health	0.638	-0.004	0.011	0.744	0.5
For−profit	Mental health	0.490	0.034	0.018	0.054	0.5
Non−profit	Mental health	0.875	-0.067	0.012	0.000	0.5

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample. $\bar{M}$ = break−down value for parallel trend assumption violations.

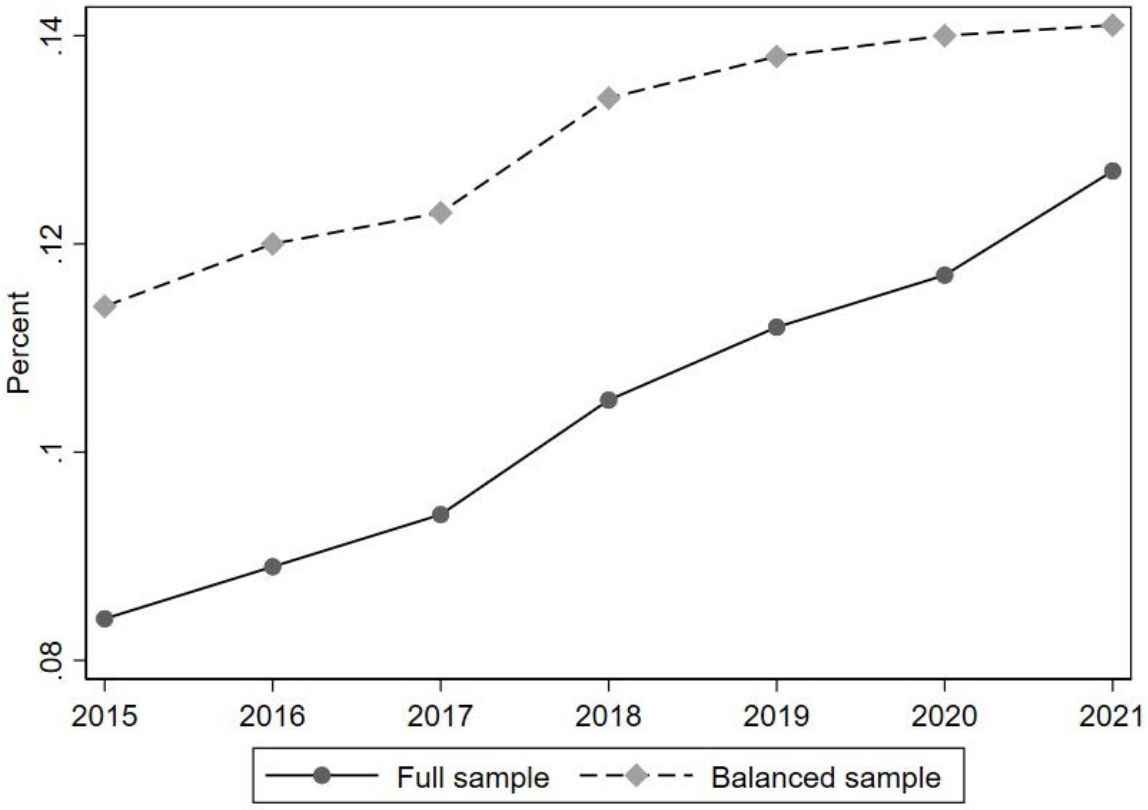
8 Appendix

Figure A1: Percentage of SUDTFs that report being OTPs over time by ownership status: MATTR 2015−2021



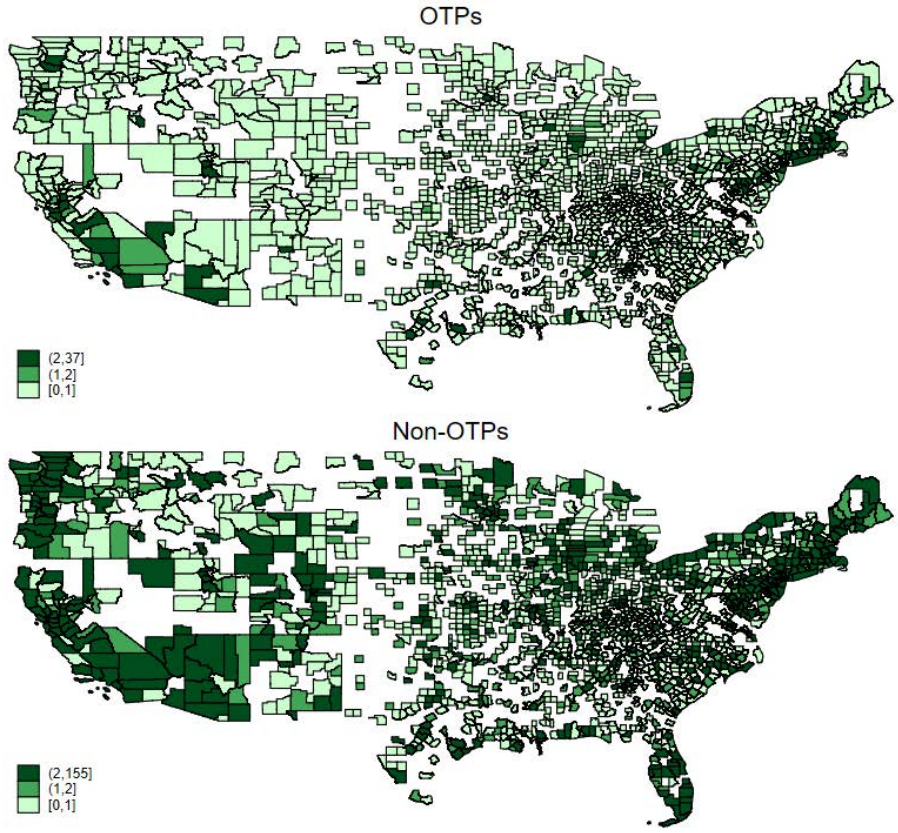
Notes: Data source is MATTR. Data are aggregated to the year−level and are unweighted.

Figure A2: Percentage of SUDTFs that report being OTPs in the unbalanced and balanced sample over time: MATTR 2015−2021



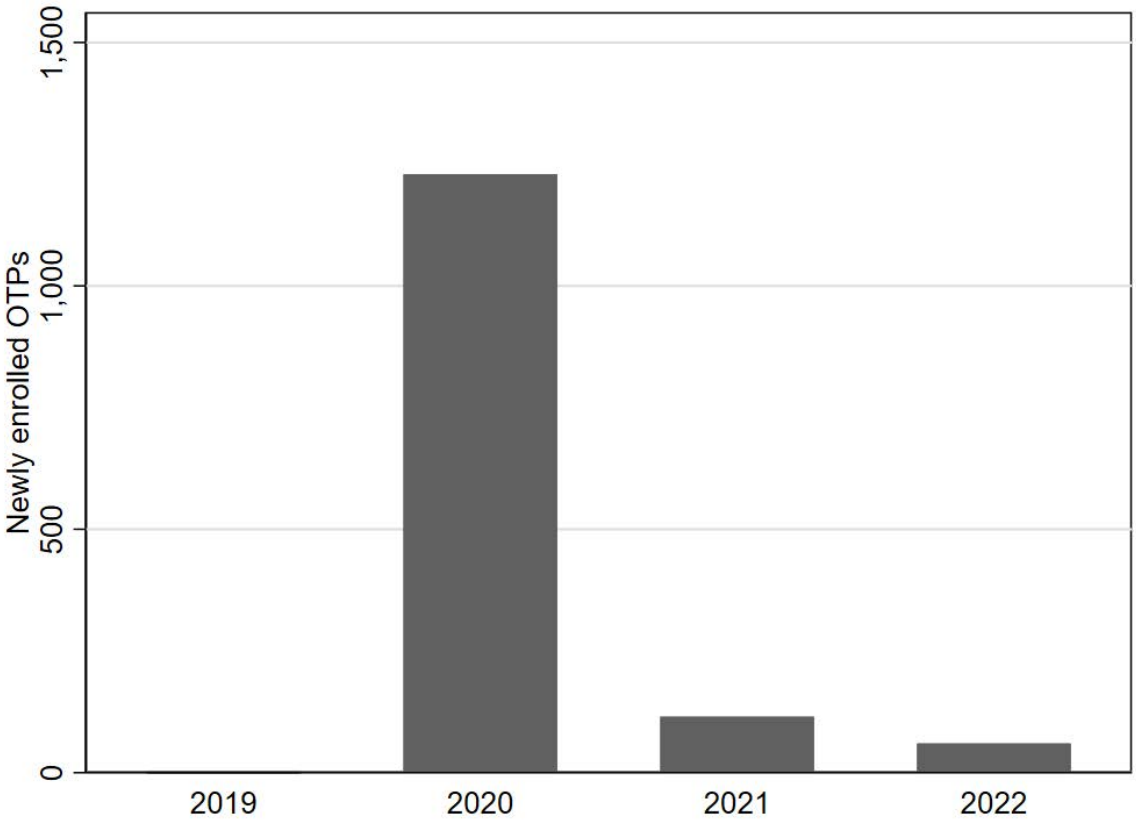
Notes: Data source is MATTR. Data are aggregated to the year−treat level. Data are unweighted.

Figure A3: Geographic distribution of OTP & non-OTP SUDTFs in 2019: MATTR



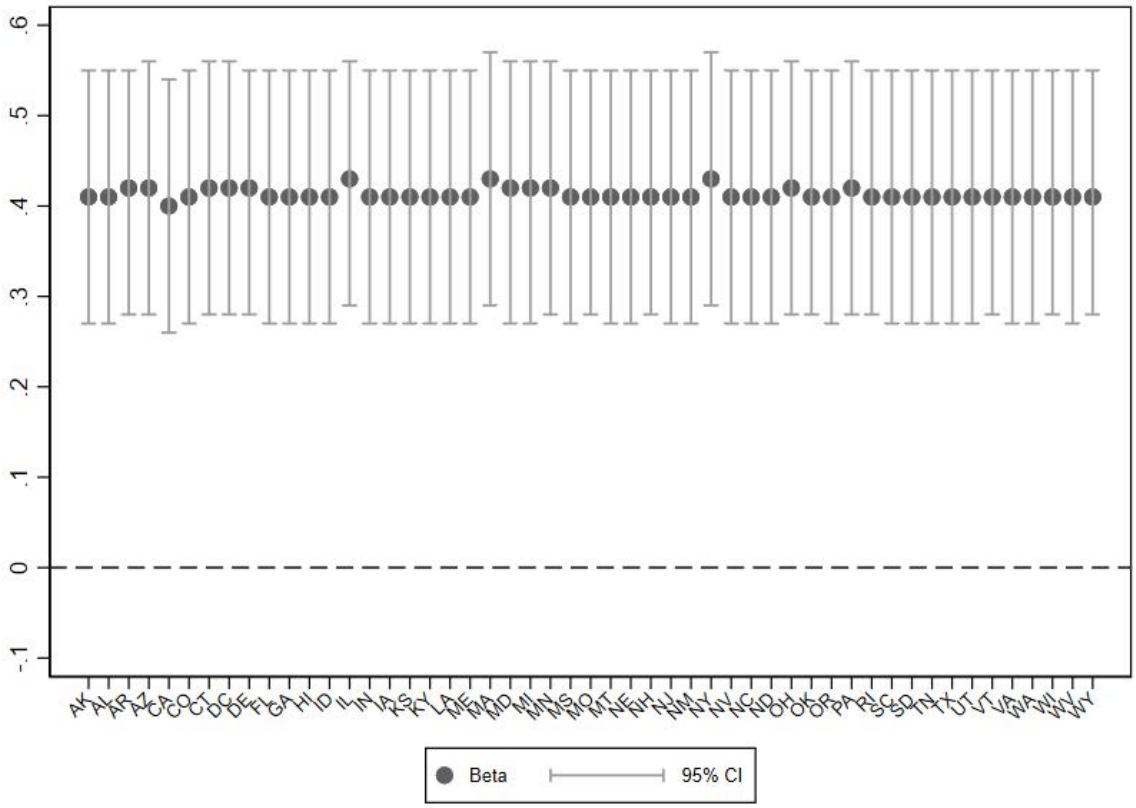
Notes: Data source is MATTR. Data are unweighted.

Figure A4: Trends in newly enrolled OTPs in Medicare: CMS 2019−2021



Notes: Data source is Centers for Medicare and Medicaid (CMS). Data are unweighted.

Figure A5: Effect of the 2020 Medicare policy on acceptance of Medicare among all OTPs (leave−one−out analysis): MATTR 2015−2021



Notes: Data source is MATTR. In this figure, we sequentially drop each state from the analysis sample and re−estimate Equation 1. The excluded state is listed on the x-axis. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. 95% confidence intervals that account for within−SUDTF clustering are reported with vertical lines.

Table A1: Comparison of characteristics between included and excluded SUDTF−years: MATTR 2015−2021

SUDTF based on inclusion in analysis sample:	Excluded	Included
Facility type		
For−profit	47%	32%
Non−profit	53%	68%
Unknown	12%	0%
OTP	7.6%	13%
OUD treatment		
Offer methadone	7.3%)	13%)
Offer buprenorphine	34%)	35%)
Accepted payments		
Accept Medicare	36%	39%
Accept private insurance	72%	72%
Accept other state insurance	73%	78%
Accept Medicaid	64%	69%
Accept any insurance	90%	91%
Accept self−pay	90%	90%
Charity care	44%	50%
Non-OUD treatment		
General healthcare	5%	5%
Screening	5%	5%
Mental health	2%	2%
Wraparound	9%	10%
Observations	44,146	47,082

Notes: Data source is MATTR. Data are unweighted.

Table A2: Pre−2020 Medicare−accepting OTPs, by year: MATTR

Characteristic	2015	2016	2017	2018	2019
OTP	100%	100%	100%	100%	100%
Offer methadone	98%	100%	99%	96%	96%
Offer buprenorphine	65%	71%	72%	80%	82%
Accept Medicare	100%	100%	100%	100%	100%
Accept private insurance	88%	86%	88%	92%	92%
Accept other state insurance	90%	91%	94%	94%	95%
Accept Medicaid	90%	92%	97%	95%	96%
Accept any insurance	100%	100%	100%	100%	100%
Accept self−pay	96%	97%	97%	98%	98%
Charity care	54%	54%	58%	56%	56%
General healthcare	4%	6%	6%	6%	6%
Screening	N/A	6%	7%	6%	7%
Mental healthcare	N/A	3%	3%	3%	3%
Wrap around services	N/A	13%	13%	13%	15%
Observations	163	185	191	224	245

Notes: Data source is MATTR. Data are unweighted.
N/A = variable is not available in MATTR in that year.

Table A3: Demographics of adults 65+ without and with any past year opioid misuse: NSDUH 2021

Sample	No opioid misuse	Opioid misuse
Male	0.45	0.36
Female	0.55	0.64
White race	0.75	0.73
Black race	0.091	0.11
Other race	0.064	0.061
Hispanic	0.092	0.10
Below the federal poverty level	0.086	0.090
Assistance program acceptance	0.16	0.23
Any health insurance	0.99	1
Medicare insurance	0.93	0.92
Private insurance	0.55	0.50
Medicaid insurance	0.12	0.20
Military insurance	0.094	0.19
Very good or excellent health	0.68	0.42
Tobacco product use in the past year	0.15	0.25
Alcohol use in the past year	0.57	0.60
Illicit drug use in the past year	0.074	1
Any SUD treatment in the past year	0.004	0.055
Any MOUD in the past year	0.001	0.021
Observations	5,343	95

Notes: Data source is the NSUDH. Data are weighted by NSDUH−provided survey weights. Sample includes respondents 65 years of age and older.

Table A4: Effect of the 2020 Medicare policy on acceptance of Medicare among all OTPs and by ownership using an event−study: MATTR 2015−2021

Sample	Year	Pre−treatment period mean	Coefficient estimate	Standard error	p−value
All facilities	2015	0.263	-0.001	0.014	0.932
All facilities	2016	0.263	0.016	0.013	0.235
All facilities	2017	0.263	0.002FV	0.012	0.885
All facilities	2018	0.263	0.007	0.009	0.421
All facilities	2019	–	–	–	–
All facilities	2020	0.263	0.334	0.016	<0.001
All facilities	2021	0.263	0.503	0.018	<0.001
For−profit	2015	0.136	-0.010	0.016	0.539
For−profit	2016	0.136	0.004	0.015	0.813
For−profit	2017	0.136	-0.015	0.014	0.262
For−profit	2018	0.136	-0.001	0.010	0.884
For−profit	2019	–	–	–	–
For−profit	2020	0.136	0.427	0.022	<0.001
For−profit	2021	0.136	0.627	0.022	<0.001
Non−profit	2015	0.468	-0.013	0.026	0.628
Non−profit	2016	0.468	0.015	0.024	0.544
Non−profit	2017	0.468	0.015	0.022	0.477
Non−profit	2018	0.468	0.010	0.018	0.559
Non−profit	2019	–	–	–	–
Non−profit	2020	0.468	0.184	0.023	<0.001
Non−profit	2021	0.468	0.311	0.029	<0.001

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. 2019 is the omitted year. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample.

Table A5: Effect of the 2020 Medicare policy change on acceptance of Medicare among all OTPs and by ownership status using a logistic regression: MATTR 2015−2021

Sample	Coefficient estimate	Standard error	p−value
All facilities	0.516	0.018	<0.001
For−profit	0.621	0.030	<0.001
Non−profit	0.357	0.041	<0.001

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with logisitc regression. Coefficient estimates are converted to average marginal effects. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. The number of observations is 6,726; 2,164; and 4,512 in the full, for−profit, and non−profit sample.

Table A6: Effect of the 2020 Medicare policy change on acceptance of Medicare among all OTPs and by ownership status using alternative definitions of treatment and comparison groups: MATTR 2015−2021

Sample	OTP definition	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
All facilities	Pre−treatment period	0.215	0.440	0.017	<0.001	7.0
For−profit	Pre−treatment period	0.103	0.544	0.021	<0.001	8.5
Non−profit	Pre−treatment period	0.424	0.268	0.028	<0.001	3.5
All facilities	Full period	0.212	0.447	0.017	<0.001	7.0
For−profit	Full period	0.102	0.553	0.021	<0.001	8.5
Non−profit	Full period	0.416	0.273	0.029	<0.001	3.5

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. $\bar{M}$ = break−down value for parallel trend assumption violations.

Table A7: Effect of the 2020 Medicare policy on acceptance of Medicare using alternative approaches to inference using all OTPs: MATTR 2015−2021

Inference method	Coefficient estimate	Standard error	p-value
Facility, state, & year clustering	0.414	0.071	0.001
State& year clustering	0.414	0.071	0.001
County& year clustering	0.414	0.073	0.001
Huber−White	0.414	0.011	<0.001
Cluster−bootstrap	0.414	0.014	<0.001

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Each row reports results from a separate regression. The number of observations is 6,726.

Table A8: Effect of the 2020 Medicare policy on acceptance of Medicare using all OTPs (potential mis-reporting of Medicare acceptance in 2019): MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value	$\bar{M}$
Medicare acceptance 2019					
Yes	0.792	0.108	0.022	<0.001	0.5
No	0.054	0.526	0.018	<0.001	10.0

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression. $\bar{M}$ = break−down value for parallel trend assumption violations.

Table A9: Effect of the 2020 Medicare policy on acceptance of Medicare among all OTPs, overall and by ownership status (excluding 2020): MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value
All facilities	0.248	0.498	0.017	<0.001
For-profit	0.123	0.632	0.021	<0.001
Non-profit	0.449	0.306	0.028	<0.001

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression.

Table A10: Effect of the 2020 Medicare policy change on acceptance of Medicare among all OTPs (placebo analysis): MATTR 2015−2019

Placebo year	Pre−treatment period mean	Coefficient estimate	Standard error	p−value
2016	0.227	0.007	0.011	0.456
2017	0.236	-0.004	0.018	0.672
2018	0.240	-0.002	0.015	0.860
2019	0.245	-0.006	0.010	0.569

Notes: Data source is MATTR. In this analysis, we use only pre-treatment data (2015-2019) and we falsely assign years 2016, 2017, 2018, and 2019 as the treatment year, and re-estimate Equation 1. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression.

Table A11: Effect of the 2020 Medicare policy change on acceptance of Medicare among all OTPs (alternative definitions of OTPs & excluding states with Medicaid programs not covering methadone for OUD): MATTR 2015−2021

Sample	Pre−treatment period mean	Coefficient estimate	Standard error	p−value
Main sample	0.248	0.414	0.016	<0.001
Loose inclusion	0.258	0.402	0.013	<0.001
Non-Medicaid†	0.256	0.401	0.016	<0.001

Notes: Data source is MATTR. The regressions include SUDTF fixed−effects and year fixed−effects. The unit of observation is an SUDTF in a year. Data are unweighted. Regressions are estimated with OLS. Standard errors are clustered at the SUDTF level. Each row reports results from a separate regression.

†The following state Medicaid programs did not cover methadone for OUD during the study period: AK, ID, KS, KY, LA, NE, SD, SC, TN, & WY.