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Medication-assisted Treatment for Opioid Use Disorder in Rhode Island: Who Gets Treatment, and Does Treatment Improve Health Outcomes?

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EXECUTIVE SUMMARY

Since the early 2000s Rhode Island has been among the states hardest hit by the opioid crisis. In response, the state has made it a priority to expand access to medication-assisted treatment (MAT) for opioid use disorder (OUD), which refers to the use of the US Food and Drug Administration (FDA)–approved medications methadone, buprenorphine, and/or naltrexone in conjunction with behavioral therapy. MAT is strongly supported by scientific evidence and endorsed by US public health officials and yet fails to reach many OUD patients. Using administrative data covering medical treatments and selected health outcomes for more than three-quarters of the Rhode Islanders covered by health insurance from mid-2011 through mid-2019, this report considers MAT's efficacy in preventing opioid overdoses in Rhode Island and sheds light on the barriers to receiving MAT. The authors find evidence that MAT, as practiced in Rhode Island, appears to reduce the risk of opioid overdose: Among patients who had an initial (nonfatal) overdose, those who had received MAT in the preceding three months were less likely to experience a second overdose. In addition, federal policies that allowed a broader set of health-care providers to prescribe buprenorphine for OUD and enabled each prescriber to treat more patients with that drug are shown to have had some success in expanding the set of patients receiving MAT in Rhode Island.

Unfortunately, we observe significant disparities in access to MAT across different groups within Rhode Island. Among individuals diagnosed with opioid dependence, those living in places with elevated poverty rates are less likely to receive buprenorphine, but they are also somewhat more likely to receive methadone. Because a treatment regimen involving methadone is much less convenient for the patient compared with one involving buprenorphine, ideally patients should have similar access to both drugs. Having Medicaid insurance as opposed to some other form of insurance is associated with a much greater chance of receiving methadone treatment, a finding that supports policies that would incentivize the expansion of Medicaid in states that have not yet done so. Women are somewhat less likely than men to receive either methadone or buprenorphine.

This research demonstrates that recent federal policies helped to increase the number of Rhode Islanders who were prescribed buprenorphine for OUD. Raising patient-number limits enabled select prescribers to serve more patients and expand the total patient pool; however, more people could be helped if more prescribers took full advantage of their prescribing limits. This research and similar findings from other states reveal that the typical buprenorphine prescriber has a caseload that is well below the maximum number of patients they could treat. A separate policy that enabled mid-level practitioners (such as physician assistants) to train to prescribe buprenorphine was also found to draw in new patients, particularly those in high-poverty Zip codes. The research also underscores the urgency of helping more OUD patients receive methadone and/or buprenorphine treatment quickly following an overdose (in hospitals, for example) and to maintain that treatment over time for a sufficient duration.

Some additional policies that could promote greater access to MAT include allowing pharmacists to prescribe buprenorphine, relaxing restrictions on the use of telehealth for obtaining buprenorphine prescriptions, and revisiting the rules about allowing take-home doses of methadone. Additional research is required on these interventions before specific recommendations can be made, but consideration of further policy adjustments is critically important given the ongoing scourge of opioid abuse and the proven ability of MAT to help those suffering from opioid use disorder. In response to the COVID-19 pandemic there has in fact been a temporary loosening of policies related to MAT in order to minimize patients' exposure to the virus while helping them to get on or stay on medications, thus offering an opportunity to evaluate the efficacy and safety of the revised measures.

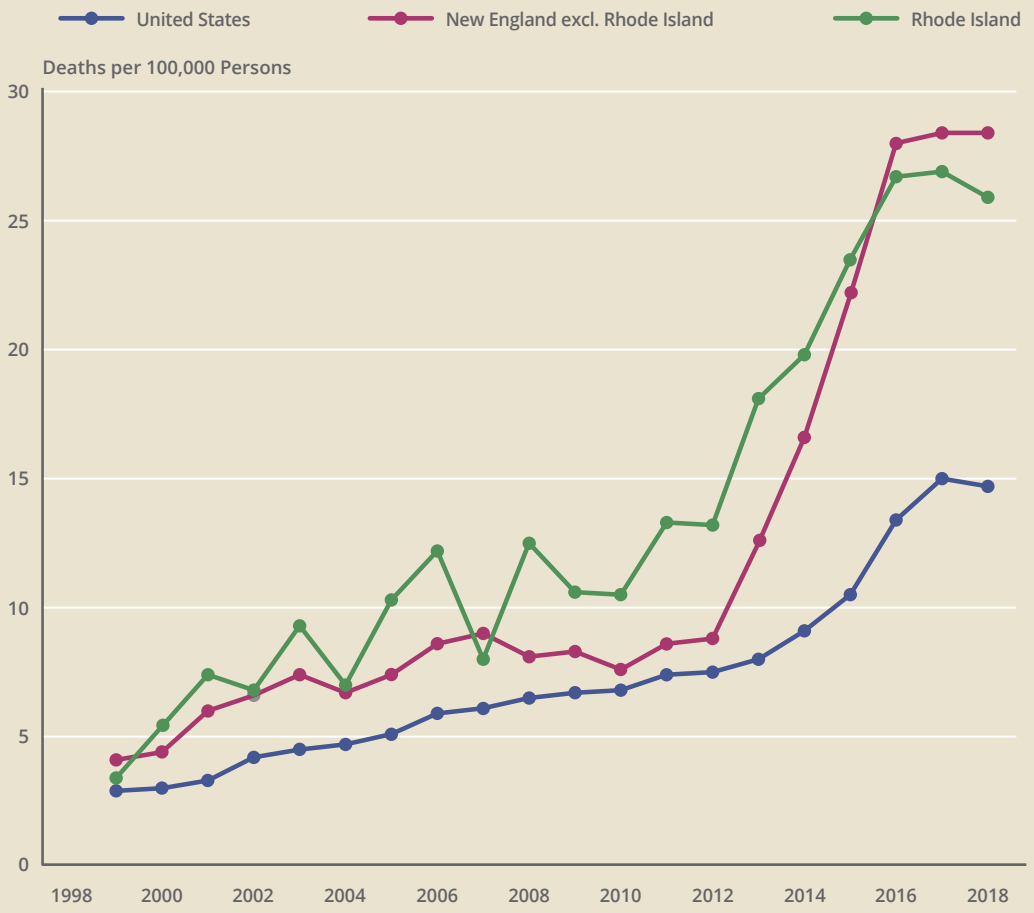
I. Motivation

Since the early 2000s, Rhode Island has ranked among the states experiencing the most severe and protracted crises of opioid abuse—see Figure 1. In 2018 the state's opioid-related overdose death rate was 10th highest in the United States among the 38 states that were ranked by the Centers for Disease Control and Prevention (CDC).[1] Recent evidence suggests that the state saw a resurgence in opioid-related mortality in 2020 due in part to the COVID-19 pandemic, after experiencing a brief period of relatively stable death rates.[2]

Figure 1

Age-adjusted Opioid Overdose Mortality Rates

Per 100,000 Persons, 1999–2018



Source: Centers for Disease Control and Prevention.

Notes: The base population in each geographic area includes all residents. Values for New England excluding Rhode Island are population-weighted average mortality rates per year among Connecticut, Maine, Massachusetts, New Hampshire, and Vermont.

1 Three other New England states—New Hampshire, Massachusetts, and Connecticut—had even higher opioid death rates per capita than Rhode Island in 2018 (Kaiser Family Foundation 2020).

2 This statement is based on Rhode Island data on overdose deaths from all drugs combined. Given previous patterns, opioid-related overdoses are likely to have accounted for a large majority of those combined deaths. See Rhode Island Department of Health website, "Drug Overdose Deaths"; and Edward Fitzpatrick, "Another Pandemic Fallout: Deaths from Accidental Drug Overdoses Are Soaring in Rhode Island," *Boston Globe*, August 5, 2020.

In August 2015, Rhode Island Governor Gina Raimondo signed an executive order establishing the Overdose Prevention and Intervention Task Force to combat the state's opioid crisis. Since then the Raimondo administration has made a priority of expanding access to evidence-based treatments for opioid use disorder (OUD), with a strong emphasis on medication-assisted treatment (MAT) in particular.[3] As part of an effort to monitor the state's progress toward that objective, the Rhode Island Department of Health (RIDOH) agreed to share HealthFacts RI—a large administrative database on medical claims—with the Federal Reserve Bank of Boston's New England Public Policy Center. Based on an analysis of these data, this report offers guidance to state and federal policymakers concerning measures to further expand access to MAT and to enhance the effectiveness of treatments for OUD. The policy guidance is based on three lines of inquiry in particular: (1) what is the efficacy of MAT in preventing opioid overdoses in Rhode Island; (2) what are the individual and contextual factors that might present barriers to receiving MAT; and (3) did federal policies implemented in 2016 to expand access to buprenorphine for OUD achieve the desired effects?

To respond to its opioid crisis, Rhode Island has prioritized expanding access to evidence-based treatments, emphasizing medication-assisted treatment (MAT) for opioid use disorder.

The remainder of the paper is organized as follows. Section II offers a preview of our main findings. Section III provides background information on OUD and MAT. Section IV describes key policy changes in the past two decades—at both the federal and state levels—that have aimed to expand access to MAT for the treatment of OUD. Section V explains why patients may still face barriers to accessing MAT despite the policy progress of the past two decades. Section VI describes the key features of the HealthFacts RI data, in advance of the three sections containing data analysis: Section VII analyzes the association between receiving MAT and opioid overdose risk among a group of Rhode Island patients; Section VIII identifies patient-level factors that are associated with either higher or lower chances of receiving MAT; and Section IX assesses the effectiveness of recent federal policies targeting buprenorphine access. Section X discusses the implications of our findings in terms of policy reforms that could help increase the efficacy and availability of programs and practices offering MAT, in Rhode Island and elsewhere.

Although Rhode Island has been a national leader in promoting access to MAT for OUD, our findings suggest that further policy innovations are called for. In particular, as our analysis reinforces the life-saving benefits of adherence to treatment regimens that include either methadone or buprenorphine, new policies aimed at increasing rates of treatment retention, and not just initiation, could help bring down the state's still-elevated opioid mortality rates.

II. Preview of Findings

First, we present evidence that medication-assisted treatment (MAT) as practiced in Rhode Island appears to reduce the risk of opioid overdose, consistent with previous observational studies of patients in Massachusetts (for example, Larochelle et al. 2018) and England (for example, Pierce et al. 2015). This evidence is based on a finding that, among patients who had an initial (nonfatal) overdose, those who had received MAT in the preceding three months were less likely to experience a second overdose. This finding reinforces the urgency of helping more opioid use

3 Other New England states also have taken concerted measures to address the opioid crisis. Vermont pioneered the "hub and spoke" system for treating OUD, which enabled otherwise underserved rural citizens to access evidence-based treatments for opioid use disorder, including MAT. Massachusetts also has taken strong actions in recent years to promote access to MAT. In contrast, New Hampshire was relatively slow to adopt a public health approach to the opioid epidemic, initially focusing on law enforcement. (See, for example, Manchester and Sullivan 2019.)

disorder (OUD) patients get into treatment that includes methadone and/or buprenorphine and to maintain that treatment for a sufficient amount of time. Although there is no uniform standard for treatment duration, longer treatment periods have been associated with better outcomes. Some sources recommend that patients stay on one of these medications for at least 12 months and that medication should be reinstated following a relapse into opioid abuse (for example, National Institute on Drug Abuse 2018). Other studies find additional benefits from treatment durations of 15 months and longer (for example, Williams et al. 2020).

Second, we find that among patients diagnosed with opioid dependence, women are less likely than men to receive either methadone or buprenorphine, and individuals with co-occurring alcohol use disorder are less likely to be treated with methadone compared with patients lacking that additional diagnosis. Individuals residing in Zip codes with elevated poverty rates (more than 20 percent of families at or below the federal poverty level) are less likely to receive buprenorphine compared with people in Zip codes with lower poverty rates, but they are also somewhat more likely to receive methadone. Medicaid patients are much more likely to receive methadone compared with patients on non-Medicaid insurance, but they are no more likely to be treated with buprenorphine. These differences in treatment patterns include controls for age and numerous other indicators of health status, and therefore the results could mean that members of certain groups face unwarranted disparities in treatment access.

Evidence indicates that MAT reduces the risk of opioid overdose, but some populations in Rhode Island face barriers to that treatment.

Third, we find evidence that a 2016 federal rule change that raised the limit on the number of buprenorphine patients allowed per provider (from 100 to 275) may have been critical in enabling some prescribers to reach more patients. A separate federal policy from 2016 enabled mid-level practitioners (such as physician assistants) to obtain training and permission to prescribe buprenorphine. The latter policy was also found to be effective in that some mid-level practitioners in Rhode Island did start prescribing the drug and drew in new patients, particularly in high-poverty Zip codes.

However, the data also suggest that many more patients in the state could be treated with buprenorphine under current policies if existing prescribers took full advantage of their prescribing limits. For example, the median active buprenorphine provider in our sample in 2017 served only about half as many patients in a given month as they could have. Even more concerning, beginning in 2016, an increasing number of providers in our sample appear to have stopped prescribing buprenorphine altogether, despite continuing to prescribe other medications.[4] These gaps in prescribing activity relative to potential, which have been observed in other states as well (Thomas et al. 2017; Stein et al. 2016), are consistent with anecdotal evidence that non-specialist, office-based practitioners face numerous challenges in maintaining a robust practice of treating OUD patients (Knudsen et al. 2011; Netherland et al. 2009).

4 Most waivers to prescribe buprenorphine do not need to be renewed. However, prescribers approved to treat as many as 275 patients at a time with buprenorphine need to renew that elevated patient limit every three years or revert to a lower patient limit.

Box 1: Defining and Diagnosing Opioid Use Disorder

The *DSM-5* (*Diagnostic and Statistical Manual of Mental Disorders,* Fifth Edition) defines an opioid use disorder (OUD) as "a problematic pattern of opioid use that leads to serious impairment or distress." (American Psychiatric Association 2013). The condition is also characterized as a chronic brain disease rooted in neurobiology (Volkow et al. 2016). The *DSM-5* includes a list of 11 symptoms that are used to diagnose an individual with either mild, moderate, or severe OUD according to the number of symptoms they display. In the insurance claims data, these different levels of the disorder are coded as either opioid abuse (indicating cases of mild OUD) or opioid dependence (for cases of either moderate OUD or severe OUD).

- Opioid Abuse (Mild OUD): Displays two to three symptoms, such as having a strong desire to use opioids even in the face of adverse consequences (addiction), failure to fulfill obligations (family, job, etc.) as a result of opioid use, loss of control over use.
- Opioid Dependence (Moderate or Severe OUD): Displays four to five symptoms (moderate OUD) or six or more symptoms (severe OUD), including those listed above as well as exhibiting physical dependence on the drug, experiencing withdrawal symptoms with reduced use, and displaying tolerance to increasingly large doses.

A third category of "opioid use" was added to the claims coding system in 2015 to characterize individuals using prescription opioids under medical supervision but not having a disorder. According to research, many cases of OUD go undiagnosed (Barocas et. al 2018). A diagnosis of opioid dependence is often necessary for insurance companies to reimburse treatments for OUD (American Society of Addiction Medicine 2017).

III. Opioid Use Disorder and Medication-assisted Treatment

Opioid use disorder (OUD) is defined by the *Diagnostic and Statistical Manual (DSM-5)* as a problematic pattern of opioid use that leads to significant impairment or distress (American Psychiatric Association 2013). See Box 1 for details. Medication-assisted treatment (MAT) refers to a class of treatments for OUD involving the US Food and Drug Administration (FDA)–approved medications methadone, buprenorphine, and naltrexone, used either alone or in combination. Both methadone and buprenorphine suppress cravings for opioids by occupying the same receptors in the brain that opioid drugs would otherwise occupy, but without producing a euphoric high when used as directed. Naltrexone suppresses cravings for opioid drugs by blocking, rather than occupying, the brain's opioid receptors and cannot produce euphoria.[5] See Box 2 for more information about these medications.

5 The injectable form of naltrexone (brand name Vivitrol) has been found to reduce illicit drug use, while the pill form of naltrexone has not been found to consistently improve patient outcomes. See, for example, Lee et al. (2018) and National Institute on Drug Abuse (2020).

Box 2: FDA-approved Medications for Opioid Use Disorder[a]

Methadone

- Full opioid agonist—fully occupies opioid receptors in the brain.
- Schedule II drug—same regulatory class as cocaine and methamphetamines.
- As a long-acting opioid agonist, methadone suppresses opioid cravings and alleviates withdrawal symptoms. Unlike short-acting opioid drugs such as heroin, it does not produce a euphoric high when used as directed.
- Administered daily by mouth at a specialized opioid treatment program (OTP). To limit diversion of the drug for street use, only limited take-home doses are available for some patients. By federal law, patients must also receive psychological counseling.
- Carries risk of overdose if misused; interacts adversely with alcohol and anti-anxiety medications.
- Patients on methadone maintenance treatment have physical dependence on the drug: They will experience withdrawal symptoms if they stop taking the medication.
- However, patients do not have an addiction to methadone: They do not have a compulsive need to use the drug and can carry on normal social functions.
- Patients are permitted to drive while on methadone. Commercial licenses are restricted in some states.
- Employers are prohibited by law from firing employees taking methadone under medical supervision.
- Longer treatment durations are associated with better outcomes; some sources recommend at least 12 months of methadone treatment.
- Used in the United States for treatment of OUD since the 1960s.

Buprenorphine

- Partial opioid agonist—only partly occupies opioid receptors in the brain.
- Schedule III drug—same regulatory class as ketamine and anabolic steroids.
- Suppresses craving, alleviates withdrawal, and as a long-acting opioid, it produces no euphoric high if used as directed.
- Prescribed only by qualified ("waivered") providers for take-home use; typically taken daily as pill or sublingual film. Also available at OTPs. If received at an OTP, the patient must also receive counseling.
- Less potential for misuse than methadone, especially when mixed with naloxone as in the popular brand-name formulation Suboxone.
- Interacts adversely with alcohol and anti-anxiety medications.
- Leads to physical dependence but not addiction when used as directed.

a The publications that informed this box are National Academies of Sciences, Engineering, and Medicine (2018), Jarvis et al. (2018), Choo (2009), and Diaper, Law, and Melichar (2014).

- Longer treatment durations are associated with better outcomes; some sources recommend at least 12 months of methadone treatment.
- Patients are permitted to drive while taking buprenorphine and can't be fired for taking the drug under medical supervision.
- Approved by the FDA for treatment of OUD in 2002.

Naltrexone

- Opioid antagonist—reduces opioid cravings and withdrawal symptoms by blocking opioid receptors rather than activating them.
- Not a controlled substance.
- Most common formulation is a monthly injection under the brand name Vivitrol.
- Pill form not proven widely effective for treatment of OUD.
- Widely available: any practitioner with prescribing privileges for other medications can prescribe or administer naltrexone.
- Patient must withdraw from all opioids, including buprenorphine or methadone, before initiating treatment with naltrexone.
- Adherence to naltrexone treatment is lower than for either methadone or buprenorphine.

The term "medication-assisted treatment" refers to the fact that such medications are typically applied in conjunction with individual and/or group counselling and other recovery support services.[6] The World Health Organization and the US Department of Health and Human Services both strongly endorse the use of MAT for opioid dependence, based on its proven effectiveness in reducing abuse of opioids, risk of fatal overdose, and all-cause mortality (Gibson et al. 2008).[7] Despite that official support, many or even most OUD sufferers receive none of the relevant medications in the course of treatment, or they receive no treatment whatsoever.[8] Within this class of treatments, opioid agonist treatment (OAT)—consisting of daily use of methadone or buprenorphine after an initial period of detoxification from other opioids—has been found to be most effective for achieving long-term abstinence from opioids of abuse (World Health Organization 2009; Krantz and Mehler 2004). The decision of whether to take methadone, buprenorphine, or naltrexone will be specific to each patient and will take into account, for example, the risks of side effects and interactions with other medications (McCance-Katz, Sullivan, and Nallani 2010). This report's analysis does not include patients treated with naltrexone due to data limitations.[9]

6 The use of these medications is sometimes abbreviated as MOUD, for "medications for opioid use disorder," or as OAT, for "opioid agonist therapy," especially in cases when complementary behavioral treatments are not applied or when the status of complementary treatments is unknown. MOUD includes methadone, buprenorphine, and naltrexone, whereas OAT includes only methadone and buprenorphine.

7 The medical literature supporting the use of MAT for OUD is vast—see, for example, Connery (2015) for a review of existing research. In addition to its benefits for individual OUD patients, MAT has been found to offer broader benefits to public health, such as reductions in HIV and hepatitis C risk behaviors as well as reductions in criminal behavior (Evans et al. 2019). Within the New England region, observational studies from Massachusetts (Larochelle et al. 2018) and Vermont (Mohlman et al. 2016) find, respectively, that MAT is associated with lower risk of fatal opioid overdose and lower healthcare expenditures.

8 See Substance Abuse and Mental Health Services Administration website,"MAT Medication, Counseling, and Related Conditions."

9 According to official Rhode Island data, only about 2 percent as many patients in the state receive naltrexone for OUD as receive either methadone or buprenorphine. Therefore, our estimates of the extent of MAT in Rhode Island are not grossly distorted as a result of omitting naltrexone patients.

IV. State and Federal Policy Efforts to Expand Access to Substance Abuse Treatment and MAT

In the past decade, a variety of policies at the federal level and in Rhode Island have been enacted with the goal of helping more patients gain access to substance abuse treatment, particularly to medication-assisted treatment (MAT) for opioid use disorder (OUD). At the federal level, the Patient Protection and Affordable Care Act (ACA), a federal law that took effect in January 2014, contains provisions to expand access to health insurance in general as well as targeted measures to increase access to mental health care and substance abuse treatment. In addition to mandating that individuals obtain health insurance and providing subsidized coverage to support that mandate, the ACA required that all insurance plans in the individual and small group markets offer coverage of mental health and substance use disorder services. Building on the earlier Mental Health Parity and Addiction Equity Act of 2010, the ACA also broadened the set of large group insurance plans that are required to offer benefits for mental health care that are as generous as the benefits they offer for medical conditions and surgical care.[10] Finally, the ACA gave states the option to offer Medicaid coverage—largely federally funded—to a much larger set of low-income individuals than was previously eligible for Medicaid, and Rhode Island opted into this expansion.[11]

In Rhode Island, Medicaid expansion brought in nearly 90,000 new enrollees, who gained full coverage for methadone treatment and full coverage of buprenorphine prescriptions.

As a result of the ACA, the number of Rhode Islanders without health insurance declined by more than half between 2013 and 2016.[12] Most of that decline was accounted for by the Medicaid expansion, which brought in nearly 90,000 new enrollees. These enrollees gained access to generous benefits for mental health and substance abuse treatment services, including full coverage for methadone treatment in specialized opioid treatment programs (OTPs) and full coverage of buprenorphine prescriptions.[13] In Rhode Island, although not in all states, incumbent (that is, pre-expansion) Medicaid enrollees had access to such benefits even before the expansion took effect.[14] Although buprenorphine is covered by Rhode Island's Medicaid plans, prior to 2017 those plans required pre-authorization of buprenorphine treatment—the provider had to submit a form justifying the treatment before the plan would cover the cost of the drug—but that provision was dropped in most cases in 2017 (Burns et al. 2016).

Since the early 2000s there have been several key policy developments at the federal level pertaining to the prescribing of buprenorphine for OUD. See Box 3 for a detailed timeline and description of these policies. In 2002, the US Food and Drug Administration (FDA) approved

10 The MHPAEA went into effect in 2010 but exempted many plans. The ACA expanded the set of plans covered by the law, but it still allows for some exceptions, including self-insured plans.

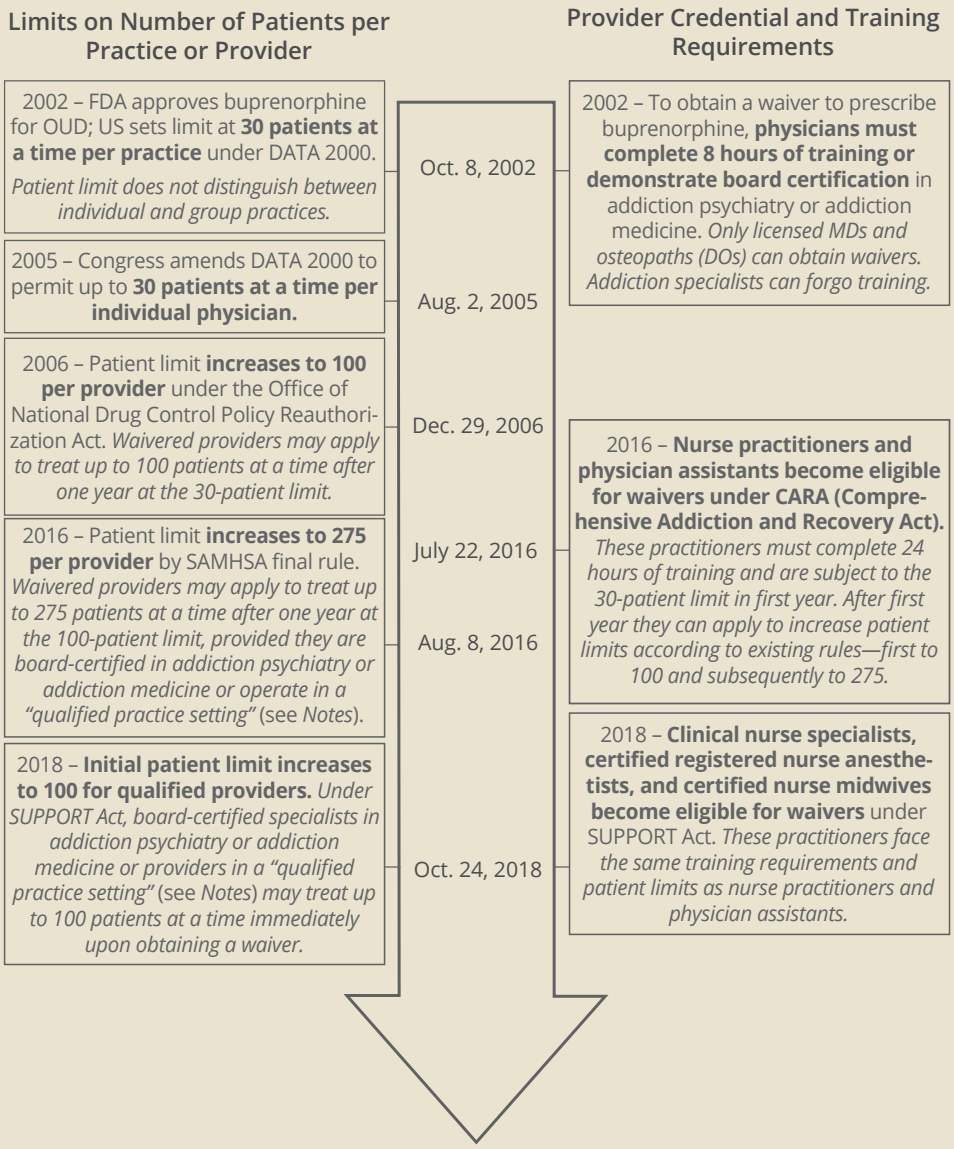
11 Under the expansion, the state extended Medicaid managed care coverage to childless adults with incomes at or below 138 percent of the poverty level, pregnant women with household incomes as high as 253 percent of the poverty level, and children in households with incomes as high as 261 percent of the poverty level. Previously, Medicaid was available only to parents with incomes at or below 138 percent of the poverty level, disabled adults, low-income seniors (as a supplement to Medicare), and others needing long-term care and special supports. Also, prior to the expansion, children in families with incomes as high as 261 percent of the poverty level and pregnant women with similar income levels received benefits under the Children's Health Insurance Program, or CHIP. See Louise Norris, "Rhode Island and the ACA's Medicaid Expansion," Healthinsurance.org, October 10, 2020.

12 See US Census Bureau, "Health Insurance in the United States: 2018 Tables," September 10, 2019.

13 See, for example, Louise Norris, "Rhode Island and the ACA's Medicaid Expansion," Healthinsurance.org, October 10, 2020.

14 See "Advancing Access to Addiction Medications: Implications for Opioid Addiction Treatment," *American Society of Addiction Medicine*, June 2013.

Box 3: Major Changes in Federal Policies Governing Buprenorphine Prescribing for Opioid Use Disorder



Notes on patient limits: The patient limit indicates the maximum number of patients to whom a given provider can prescribe buprenorphine for opioid use disorder (OUD) at any given time across all the provider's practice locations. A given patient counts toward a provider's limit as long as they retain an open prescription. A prescription is considered open if the days elapsed since it was filled are fewer than the total intended days' supply of the prescription. A "qualified practice setting" is one that offers meaningful referrals for complementary supportive services, offers access to providers during off-hours emergencies, accepts at least one type of third-party payment, and is registered with the state's Prescription Drug Monitoring Program, among other requirements.

Notes on the waiver-application and training processes: All providers who are eligible to apply for waivers to prescribe buprenorphine must submit an application through the SAMHSA website. The application requests proof of the practitioner's credentials and certifications, including their capacity to refer patients for appropriate counseling and other services. Practitioners who are not board-certified specialists in addiction psychiatry or addiction medicine must prove that they have completed all necessary training requirements. The trainings cover topics such as relevant legislation, pharmacology, safety, patient assessment, and more. SAMHSA reviews applications within 45 days of receipt. A waiver may be revoked if a provider is found to have made any misrepresentations in their application or violates the Controlled Substance Act. Practices with waivered providers are subject to audits by DEA to ensure compliance with anti-diversion measures and other requirements. Waivers to treat 275 patients must be renewed every three years or the patient limit will revert to a lower level. Other waivers are not subject to renewal. For more information visit the SAMHSA website.

Box 4: Rhode Island Policies and Programs Developed to Expand Access to Medication-assisted Treatment for Opioid Use Disorder

Under Governor Gina Raimondo, Rhode Island in 2016 became the first state in the country to offer medication-assisted treatment (MAT) to prison inmates, and it has since seen a steep decline in the number of overdose deaths among former inmates (Green et al. 2018). Between 2016 and 2020, Rhode Island established 14 Centers of Excellence in various locations, each offering a high standard of care for opioid use disorder (OUD), including MAT in conjunction with other evidence-based treatments. In 2017, the state formed a partnership with Brown University's Warren Alpert Medical School to incorporate training in addiction treatment into the curriculum and allow graduates who remain in Rhode Island to earn automatic waivers to prescribe buprenorphine in lieu of standard training requirements.[b] This program became the model for a provision of the federal Substance Use Disorder Prevention that Promotes Opioid Recovery and Treatment (SUPPORT) for Patients and Communities Act of 2018, which similarly enables any graduate of a medical school that incorporates an approved addiction curriculum to apply for a buprenorphine waiver upon graduation without further training (Shapiro et al. 2019).

b See Gary Enos, "Partnership in R.I. Will Accelerate Buprenorphine Training," *Addiction Professional*, July 13, 2017.

buprenorphine for the treatment of OUD, and the Drug Addiction Treatment Act of 2000 (DATA 2000, which took effect in 2002) allowed psychiatrists and primary care physicians (MDs) to become qualified to prescribe the drug to a limited number of patients. Also, under DATA 2000, opioid treatment programs (OTPs) gained permission to administer buprenorphine in person for OUD, whereas previously such programs had only one medication option—methadone—for treating OUD. Subsequent policies have expanded the set of providers that can seek permission to prescribe buprenorphine and increased the limits on the number of patients allowed per provider. An increase in the number of waivered providers of buprenorphine has been associated with increased rates of buprenorphine prescribing as well as decreased rates of opioid prescribing (Wen et al. 2018). Separate from the policy developments at the federal level, Rhode Island legislators have passed several bills in recent years seeking to expand access to MAT in the state.[15] These various pieces of state legislation are described in Box 4.

15 See Charles Townley, "Rhode Island Becomes Latest State to Pass Opioid Legislation in 2016," *National Academy for State Health Policy* (blog), July 11, 2016.

V. Barriers to Treatment

Despite its proven benefits, and despite policy actions in recent years, medication-assisted treatment (MAT) still does not reach most opioid use disorder (OUD) patients in the United States.[16] According to some sources, nationally fewer than 10 percent of patients with diagnosed OUD receive MAT.[17] Furthermore, many OUD sufferers receive no treatment of any kind for their condition—from 2004 through 2013, only about one-fifth of OUD sufferers received MAT or any other treatment (Saloner and Karthikeyan 2015). The fact that MAT does not reach more patients owes to a combination of regulatory, social, financial, and geographic factors.

Both methadone and buprenorphine are long-acting opioid agonists. Although these drugs differ from short-acting opioids such as heroin and oxycodone that produce a sudden euphoric high, they are nonetheless capable of being abused for non-therapeutic purposes. Methadone and buprenorphine therefore have street value and are subject to diversion.[18] Accordingly, strict federal and state regulations govern their use in medical applications (Institute of Medicine 1995). These regulations have the effect of limiting patients' ability to access these medications—for example, by requiring that patients travel daily to a specialized opioid treatment program (OTP) to receive methadone and by requiring extra training for health-care providers wishing to prescribe buprenorphine.[19] See Boxes 2 and 3 for details. Also due to regulations, OTPs that dispense methadone and office-based practices that prescribe buprenorphine face more expensive staffing requirements compared with those that do not offer these medications (Knudsen et al. 2011). Some states impose caps on the number of facilities that can be certified to dispense methadone, and even without such caps, few communities are willing to permit methadone clinics. For all of these reasons, many patients, especially those in rural areas, face geographic barriers to accessing facilities that dispense methadone and/or providers that are qualified to prescribe buprenorphine (Pullen and Oser 2014; Johnson, Mund, and Joudrey 2018).

Geography, social stigma, and cost can impede patients from receiving MAT; but Rhode Island has made significant progress to expand MAT despite such barriers.

Also stemming from the fact that methadone and buprenorphine are opioid agonists, MAT suffers from the social stigma that it substitutes one addiction for another. To cite just one powerful example of this stigma, methadone and buprenorphine use is discouraged within the 12-step recovery community, and patients taking these medications are not considered "truly sober."[20] To counter this stigma, health authorities, including the National Institute on Drug Abuse (NIDA), stress that although patients on opioid agonist therapy exhibit physical dependence on these drugs—they will experience withdrawal symptoms if they stop taking them—they are not addicted to them in a way that causes self-destructive or criminal behavior and can therefore regain normal social functioning. Furthermore, the NIDA and other authorities argue that OUD is a chronic brain disease, not a moral failure, and that the treatment of OUD should be viewed through the same lens used to view the treatment of other chronic conditions, such as diabetes and hypertension.[21]

16 See, for example, National Academies of Sciences, Engineering, and Medicine (2019).

17 See Emma Sandoe, Carrie E. Fry, and Richard Frank, "Policy Levers That States Can Use to Improve Opioid Addiction Treatment and Address the Opioid Epidemic," *Health Affairs Blog*, October 2, 2018.

18 Fatal overdoses involving methadone do occur, although the rate of such overdoses declined significantly between 2007 and 2014 (Faul et al. 2017).

19 Some patients can get take-home doses of methadone, but only on a limited basis (Department of Health and Human Services 2001; Walley et al. 2012).

20 See Katrine J. Andersen and Cecilie M. Kallestrup, "Rejected by A.A.: How the 12 Step Program and Its Decades-old Philosophy Are Exacerbating the Opioid Crisis," *The New Republic*, June 27, 2018.

21 See National Institute on Drug Abuse (2018).

Cost is another potential factor, as not all health insurance plans cover MAT. In states that opted into the Affordable Care Act's Medicaid expansion—including Rhode Island—the law requires that Medicaid reimburse patients for methadone, but in 13 non-expansion states Medicaid still does not offer such reimbursements.[22] Before 2020, Medicare plans did not cover methadone treatments.[23] The retail price of Suboxone, a popular formulation of buprenorphine, runs from $6 to $24 per day, depending on the dosage and the pharmacy.[24] One source estimated the average cost of methadone treatments and complementary services at $126 per week as of 2018 (National Institute on Drug Abuse 2020). Even when insurance covers MAT, some providers choose not to accept patients with some types of insurance (often Medicaid) due to inadequate reimbursement rates, and some refuse to accept any form of health insurance (Knudsen and Studts 2019; Flavin et al. 2020).

Rhode Island appears to have made significant progress in expanding access to MAT despite the many potential barriers. The state receives significant federal funds for fighting the opioid crisis and dedicates a large share of these funds to treatment and recovery programs. It was among the top seven states in the country in terms of methadone clinics per capita as of 2018,[25] and as of 2012, Rhode Island had more than twice the national average of buprenorphine prescribers per capita (Jones et al. 2015). As shown below, the share of OUD patients in the HealthFacts RI data who have ever initiated either methadone or buprenorphine appears to be greater than the estimates of average MAT rates nationwide, and previous research from the Federal Reserve Bank of Boston (Burke 2019) finds that OUD patients in Rhode Island were more likely to receive MAT compared with the average patient in the United States. However, as the number of opioid overdose deaths in the state continues to be elevated, it remains important to assess whether MAT works as promised to protect patient health and to identify any gaps between treatment capacity and treatment effectiveness.

VI. Overview of HealthFacts RI Data

HealthFacts RI is the official name of the All-Payer Claims Database (APCD) for the state of Rhode Island. In any given month the data cover most Rhode Island residents who held medical and/or pharmacy insurance in that month, with the exception of people enrolled in plans with fewer than 3,000 total enrollees and, beginning in late 2015, those enrolled in self-insured plans.[26] Dental insurance information is not included. For the included population, the data set contains limited demographic information (age, gender), information on the insurance plan (company name and plan type), and detailed information for each specific claim filed in association with health-care services (inpatient and outpatient) received by an individual and prescriptions filled by

22 Grooms and Ortega (2019) find that the Medicaid expansion under the ACA resulted in increased admissions to treatment for substance abuse disorders, but they do not specify whether MAT increased disproportionately. Maclean and Saloner (2017) find that Medicaid-reimbursed prescriptions for some forms of MAT (including those involving buprenorphine and naltrexone) increased significantly in Medicaid-expansion states following the enactment of the ACA.

23 See Centers for Medicare and Medicaid Services, "Trump Administration Takes Steps to Expand Access to Treatment for Opioid Use Disorder," November 1, 2019.

24 See, for example, OpioidTreatment.net, "Does Insurance Cover the Cost of Suboxone (Buprenorphine) Treatment?" July 22, 2018. Suboxone also includes the opioid antagonist Naloxone to prevent abuse. Although methadone alone is inexpensive, the out-of-pocket cost of comprehensive treatment in an OTP, including methadone administration and related treatment services, may run as high as $125 per week. See, for example, Alison Knopf, "How Treatment in an OTP Is Paid for: It Costs a Lot More than the Price of the Medication," *Addiction Treatment Forum*, April 18, 2016.

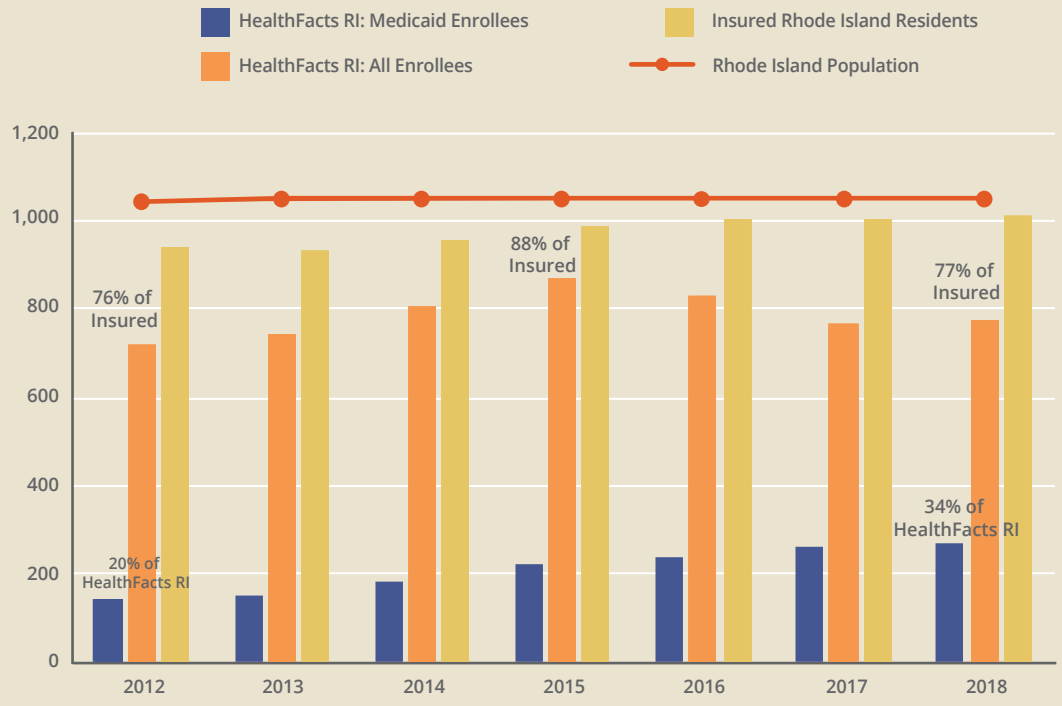
25 See Christine Vestal, "Long Stigmatized, Methadone Clinics Multiply in Some States," *Stateline*, October 31, 2018.

26 In late 2015, the US Supreme Court ruled that self-insured plans could not be mandated to provide claims data to APCD systems. A self-insured or self-funded plan is a type of coverage offered by some employers in which the employer covers the cost of claims as they accrue rather than paying an insurance premium to an insurance carrier.

Figure 2

Average Monthly HealthFacts RI Enrollees vs. All Rhode Island Residents

Fiscal Years 2012–2018



Sources: Authors' calculations using data from HealthFacts RI, US Census Bureau/Haver Analytics, and American Community Survey.

Notes: All numbers are in thousands of individuals. Values represent actual or estimated monthly averages for the given fiscal year of the number of individuals in each population or subgroup. HealthFacts RI Medicaid enrollees exclude those with both Medicaid and Medicare insurance. The number of insured Rhode Island residents was calculated as the percentage of Rhode Islanders with health insurance (estimated for the fiscal year based on the American Community Survey) times the monthly average RI population in the fiscal year.

the individual. Treatments and prescriptions paid for out of pocket, even by individuals carrying insurance, are not recorded in the data, nor are treatments received by uninsured patients.[27]

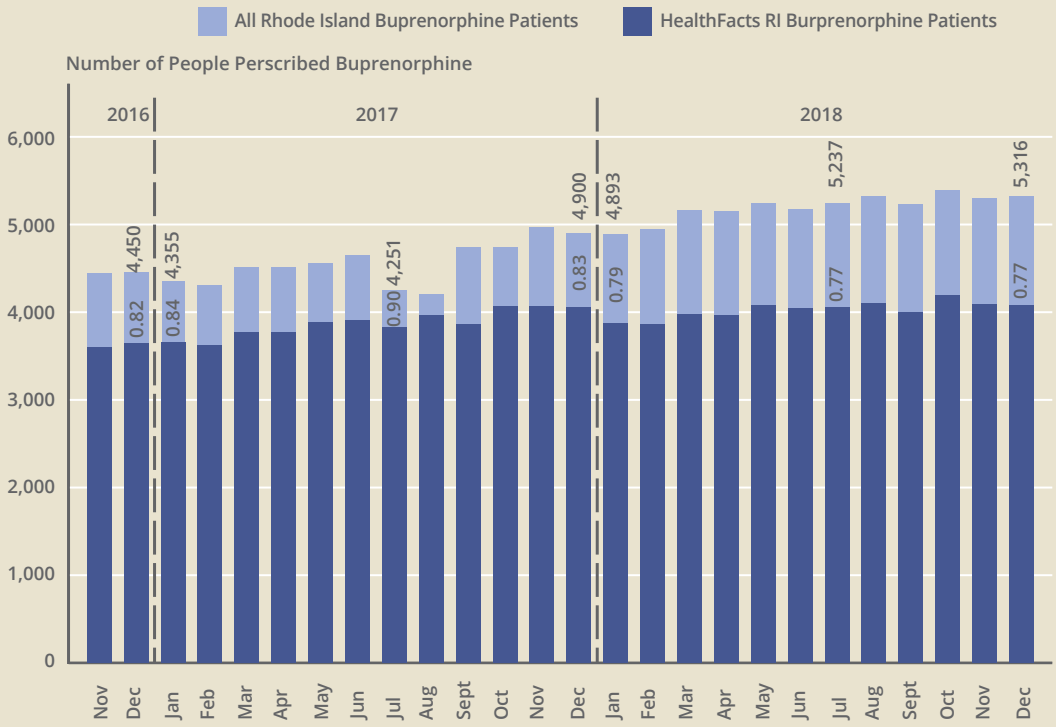
Figure 2 illustrates patterns in the coverage of the data relative to the overall Rhode Island population and the insured population from fiscal years 2012 through 2018. The total population of Rhode Island has stayed relatively constant in recent years, while the share of the population covered by health insurance has increased owing to the Affordable Care Act and the associated Medicaid expansion in the state starting in January 2014. In fiscal 2012, HealthFacts RI enrollees represented 76 percent of all insured Rhode Island residents; by fiscal 2015 that figure had

27 Beyond proprietary insurance claims data, rates of OUD diagnosis and uptake of MAT are available from several public data sources. These sources include the National Survey of Drug Use and Health (NSDUH), the National Survey of Substance Abuse Treatment Services (N-SSATS), and the Treatment Episodes Data Set (TEDS), all of which are maintained by the Substance Abuse and Mental Health Services Administration (SAMHSA). The NSDUH, instituted in 1971, measures the prevalence of OUD and other substance abuse disorders at the state and national levels. Both the N-SSATS (since 2000) and the TEDS (since 1992) provide measures of the prevalence of MAT for the treatment of OUD, although each uses a different method.

Figure 3

Monthly Buprenorphine Patients: HealthFacts RI vs. All Rhode Island Residents

November 2016–December 2018



Sources: Authors' calculations using HealthFacts RI and Prevent Overdose RI.

Notes: "HealthFacts RI Buprenorphine Patients" refers to the number of unique buprenorphine recipients in the month (restricted to patients aged 18 and older with Rhode Island Zip codes and non-denied pharmacy claims). "All RI Buprenorphine Patients" refers to the number of buprenorphine recipients as reported on the Prevent Overdose RI website. The numbers reported on that website draw on data from the Rhode Island Department of Health (RIDOH), Substance Abuse and Mental Health Services Administration (SAMHSA), and Rhode Island Department of Behavioral Healthcare, Developmental Disabilities and Hospitals (BHDDH). The numbers placed above selected HealthFacts RI bars present the number of buprenorphine patients captured by HealthFacts RI as a share of all Rhode Island buprenorphine patients.

increased to 88 percent, but by fiscal 2018 it had fallen to 77 percent, due to the exit from the sample of enrollees in self-insured plans in fiscal 2016. The share of HealthFacts RI enrollees with Medicaid coverage also increased significantly over the time period, mostly due to the large increase in Medicaid enrollees starting in January 2014. These changes in sample composition need to be kept in mind when analyzing trends in treatments and outcomes.

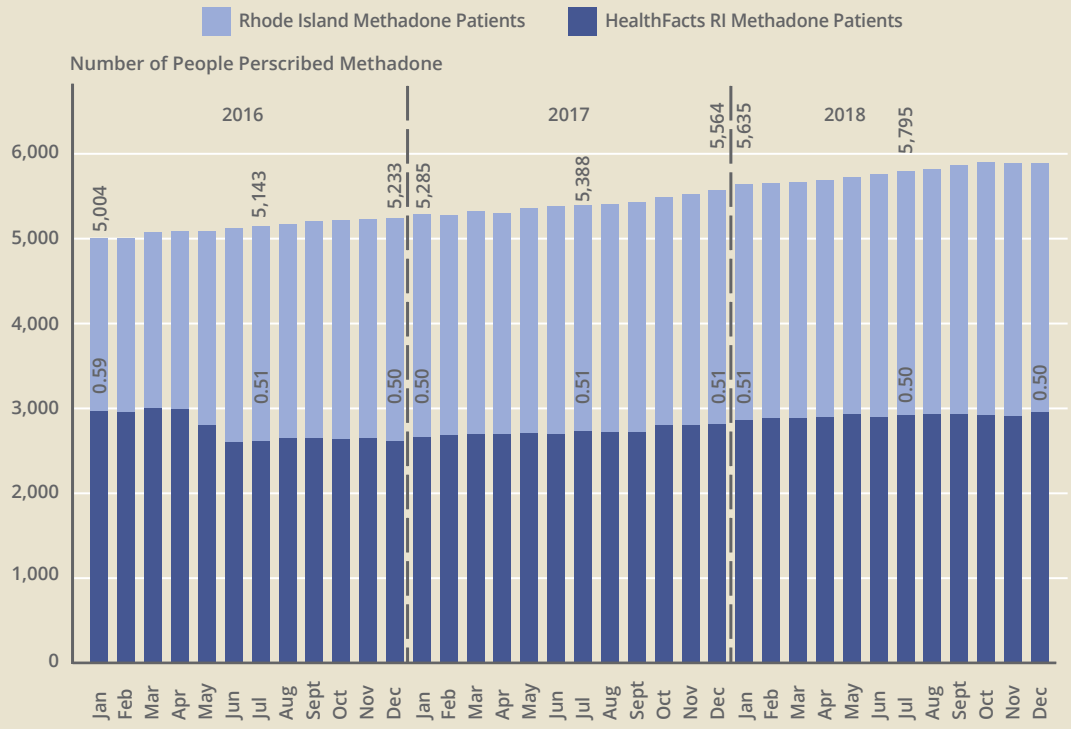
The fact that our sample does not observe all individuals receiving health care in Rhode Island, and may miss some treatments even among observed enrollees, also must be taken into account when assessing the trends in outcomes of interest in our data. For later years, external sources of data can be used to assess the validity of the HealthFacts RI data along certain dimensions. Figure 3 shows the monthly numbers of unique patients receiving buprenorphine in Rhode Island based on two sources: HealthFacts RI and the Rhode Island Prescription Drug Monitoring Program (PDMP). The latter source should offer a near-complete census of buprenorphine patients receiving the drug as a prescription, as it observes prescriptions regardless of the form of payment.[28]

28 The PDMP numbers do not include individuals receiving buprenorphine in person at an opioid treatment program, as those treatments are not registered with the PDMP, nor do they include people who receive the drug in a state correctional facility (American Society of Addiction Medicine 2018).

Figure 4

Monthly Methadone Patients: HealthFacts RI vs. All Rhode Island Residents

January 2016–December 2018



Sources: Authors' calculations using HealthFacts RI and Prevent Overdose RI.

Notes: "HealthFacts RI Methadone Patients" refers to the number of unique methadone-treatment recipients in the month (restricted to patients aged 18 and older with Rhode Island Zip codes). "All RI Methadone Patients" refers to the number of methadone-treatment recipients as reported on the Prevent Overdose RI website. The numbers reported on that website draw on data from the Rhode Island Department of Health (RIDOH), Substance Abuse and Mental Health Services Administration (SAMHSA), and Rhode Island Department of Behavioral Healthcare, Developmental Disabilities and Hospitals (BHDDH). The numbers placed above selected HealthFacts RI bars present the number of methadone patients captured by HealthFacts RI as a share of all Rhode Island methadone patients.

Buprenorphine administered directly in OTPs is not observed in either the PDMP or in our data. However, the vast majority of recipients obtain the drug through a prescription.[29] From January 2016 through December 2018, the number of buprenorphine patients in the HealthFacts RI data captured, on average, about 81 percent of total buprenorphine patients recorded by the PDMP, with a range of 76 percent (September 2018) to 94 percent (August 2017). The coverage rate is lower on average in 2018 than in either 2016 or 2017, owing to the fact that as of January 2018 the HealthFacts RI data lack the prescription drug claims for patients with Medicare fee-for-service insurance.[30]

Figure 4 shows the corresponding data for methadone patients. Coverage starts at 59 percent in January 2016, but then it declines to roughly 50 percent by June 2016 and hovers close

29 For rates of buprenorphine treatment from 2004 through 2015 in OTP facilities and non-OTP facilities, see Cathie E. Alderks, "Trends in the Use of Methadone, Buprenorphine, and Extended Release Naltrexone at Substance Abuse Treatment Facilities: 2003–2015 (Update)," *The CBHSQ Report*, August 22, 2017.

30 Starting in January 2019, the HealthFacts RI data also lack medical claims for Medicare fee-for-service patients. The missing data are to be furnished to us at a later date.

to the latter rate for the remainder of the period. The lower coverage rates for methadone compared with buprenorphine most likely reflect the fact that methadone patients are less likely than buprenorphine patients to have health insurance, and methadone patients can sometimes access public subsidies (such as state block grant funds) to pay for their treatment. (Insured patients cannot access such funds unless their insurance plan does not cover methadone treatments.) The decline in the coverage rate after early 2016 points to a known issue in the data: Substance-abuse-related claims—and methadone treatments in particular—have been subject to redactions, or "scrubbing," which became increasingly common in our data set beginning in late 2015. Additional analysis reveals that the sudden decline in methadone claims in 2016 was concentrated in one health insurer in particular: United Healthcare. To ensure that erratic reporting of methadone treatments does not drive the results of analyses pertaining to such treatment, we either present results that exclude all observations associated with United Healthcare (as in Section VIII), or we present results that include such observations and check that those results are robust to their exclusion (as in Section VII).

VII. Analysis of the Role MAT Plays in Reducing Repeated Overdose Risk

Previous research based on clinical trials indicates that treatment with either methadone or buprenorphine promotes abstinence from illicit opioids and reduces the risks of opioid misuse. Accordingly, it is expected that medication-assisted treatment (MAT) should also reduce the risks of opioid overdose, whether fatal or nonfatal (National Academies of Sciences, Engineering, and Medicine 2019). However, evidence on the association between MAT and opioid overdose risk comes from a relatively small set of observational studies, and while some find that MAT reduces overdose risk (Larochelle et al. 2018; Pierce et al. 2015), others yield mixed results (Sordo et al. 2017; Kelty and Hulse 2017). In general, more research is needed to assess the importance of MAT in reducing overdose risk, and policymakers in Rhode Island in particular have an interest in understanding whether MAT as delivered in their state confers the expected benefits to health. The HealthFacts RI medical claims data identify opioid overdoses that resulted in either an emergency department (ED) visit or a hospital admission. Although the records do not indicate explicitly whether an overdose was fatal, we can infer that an overdose was nonfatal if the same individual has medical claims after the overdose event.

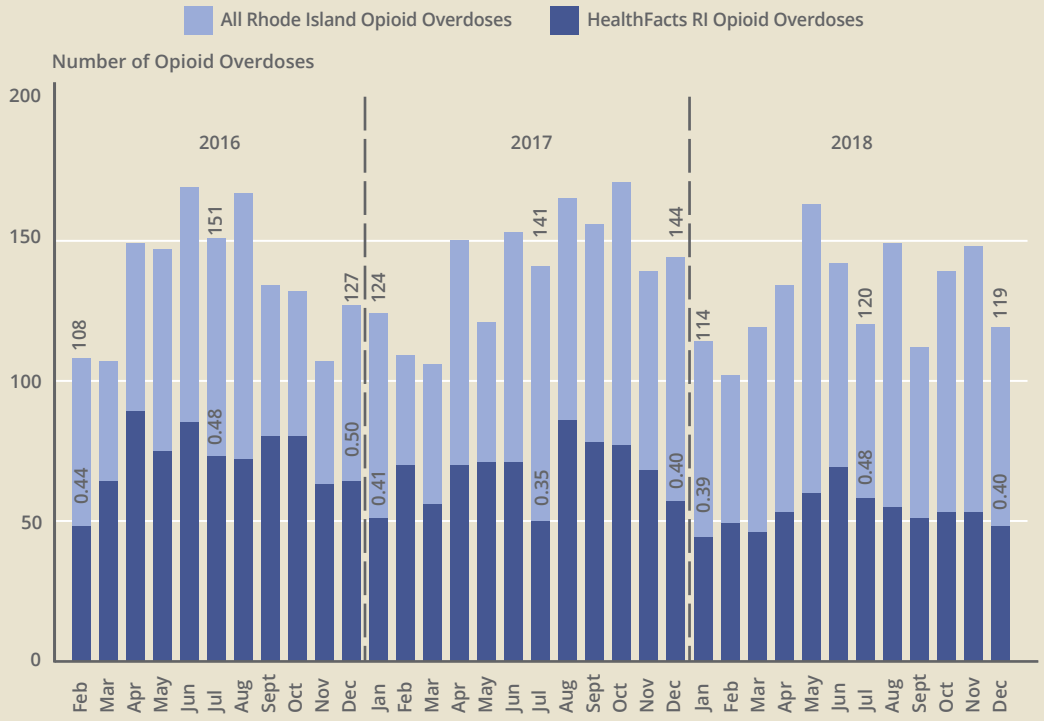
The risk of having a second overdose at a given number of months after the first overdose decreases with the number of MAT treatments in the preceding three months.

The HealthFacts RI database misses a significant share of the overdoses that occur in Rhode Island and are treated in emergency departments. From February 2016 through December 2018—the period for which the Rhode Island Department of Health (RIDOH) has furnished complete monthly counts of ED-treated overdoses in the state—the monthly overdose counts in our data capture 35 percent to

Figure 5

Monthly Opioid Overdoses in Emergency Departments: HealthFacts RI vs. All Rhode Island Residents

February 2016–December 2018



Sources: Authors' calculations using HealthFacts RI and Prevent Overdose RI.

Notes: "HealthFacts RI Opioid Overdoses" refers to the number of opioid overdoses in the month (restricted to emergency department visits observed in HealthFacts RI among patients aged 18 and older with Rhode Island Zip codes). A given patient may account for more than one overdose in a month provided a given overdose occurs at least two days after the previous one. "All RI Opioid Overdoses" refers to the number of opioid overdoses per month (restricted to emergency department visits) as reported on the Prevent Overdose RI website. The numbers reported on that website draw on data from the Rhode Island Department of Health (RIDOH), Substance Abuse and Mental Health Services Administration (SAMHSA), and Rhode Island Department of Behavioral Healthcare, Developmental Disabilities and Hospitals (BHDDH). The numbers placed above selected HealthFacts RI bars present the number of opioid overdoses captured by HealthFacts RI as a share of all Rhode Island opioid overdoses.

53 percent of all ED-treated overdoses in Rhode Island, depending on the month, or roughly 48 percent on average for that nearly three-year period (Figure 5). This undercount occurs because our data do not observe overdoses among uninsured patients, patients with exempt insurance plans, and insured patients who pay out of pocket.[31] In a significant number of cases, opioid overdose patients are never transferred to a hospital but instead receive treatment in an ambulance or on the street or receive no treatment whatsoever. Neither the official tally of emergency-department overdoses nor our numbers include any such cases.

We analyze the association between receiving MAT in the recent past and the risk of having a second opioid overdose following an initial (nonfatal) opioid overdose, controlling for numerous

31 Another potential source of undercounting in our numbers relates to how we count multiple overdoses for the same patient that occur within a short time span. In our method, to count as a new overdose for the same patient, the event must have occurred at least two days after the previous event. We do not know how such cases are counted in the official numbers. We also omit overdoses involving patients who were younger than 18 years old at the time.

potential confounding factors. In cases where a second overdose occurs, it cannot be determined from the data whether the second overdose was fatal. Analyzing repeated overdose risk among patients with at least one overdose helps to eliminate unobserved differences in illness severity that would also predict a higher chance of receiving MAT.[32] However, this restriction means that the results may not generalize to the question of whether MAT can reduce the risk of having at least one overdose as opposed to none.

We begin by assembling a sample of patients who were observed over an extended, overlapping period of time to ensure that we obtain a relatively complete picture of medical histories and to minimize unobserved differences in patient characteristics and potential risk factors for repeated overdose. This sample is named the *incumbent panel,* in reference to all of its members having entered the sample before the Affordable Care Act and associated Medicaid expansion took effect in Rhode Island.[33] We further restrict the analysis to patients in the incumbent panel who had at least one nonfatal opioid overdose—treated in either the emergency department or in an inpatient hospital setting—and who were observed (at a minimum) in each of the three months immediately following their initial overdose. Requiring this minimum follow-up time reduces potential biases resulting from selective exit from the sample.[34] The resulting *nonfatal opioid overdose sample* contains more than 66,000 patient-by-month observations pertaining to 1,755 unique individuals, 412 of whom (just over 23 percent) are observed to have had two or more opioid overdoses.[35] All sample members were at least 18 years of age when they suffered their first overdose.

32 Our data indicate that individuals who have had at least one overdose are also much more likely to have ever received MAT compared with those who have never had an overdose. This association could arise because (a) having an overdose reveals the severity of an individual's opioid disorder and prompts health-care providers to recommend MAT, and/or (b) those at higher risk of having an overdose may exhibit signs of a more severe disorder—and therefore be prescribed MAT at higher rates—even before having their first overdose.

33 To build the incumbent panel we first retain only observations with a known medical insurance type. An individual must have at least 33 retained observations dated between the start of January 2013 and the end of December 2015, must have been at least 19 years of age and residing in Rhode Island as of January 2013, and must not have switched between Medicaid and non-Medicaid insurance plans before January 2017 or moved out of state after January 2013. We also exclude individuals who exhibit inconsistent age changes or gender changes over time. The resulting panel data set includes all retained observations—regardless of date—for the set of qualifying individuals.

34 Our results are qualitatively similar without this requirement as well as when we require a minimum of six months of follow-up.

35 For an overdose to count as a second overdose it must occur in a calendar month later than when the initial overdose occurred and must occur at least two days later than the first overdose. For example, overdoses occurring on March 31 and April 1 of the same year are treated as the same event, but overdoses occurring on March 31 and April 2 are treated as separate events. In most of the analysis the overdose date is given as a month rather than a specific date.

Table 1

Percentage of Sample with Selected Characteristics By Number of Overdoses

Nonfatal Opioid Overdose Sample

	All	One Overdose	Two or More Overdoses
Receives MAT (Ever)*	49.9	44.1	68.9
Number of Last 3 Months on MAT	0.5	0.5	0.7
Starts MAT Before First Overdose	33.5	31	41.7
Starts MAT After First Overdose	16.4	13.1	27.2
Alcohol Use Disorder Diagnosis (Ever)	56.1	51.2	72.3
Opioid Dependence Diagnosis (Ever)**	71	66	87.4
Opioid Use/Abuse Diagnosis (Ever, At Most)**	5.8	6.2	4.4
Hepatitis C Diagnosis (Ever)	34.8	30.2	49.8
Depression Diagnosis (Ever)	88.9	87.9	92
Anxiety Diagnosis (Ever)	88.4	86.9	93.4
Other Mental Illness Diagnosis (Ever)	93.2	92.1	96.8
Other Substance Abuse Disorder Diagnosis (Ever)	87	84.2	96.1
Fills Both Opioid and Benzodiazepine Rxs Same Month (Ever)	53.4	53.5	53.4
Behavioral Treatment (Ever)	66.7	64.2	75
First Overdose Age 18–30	15.4	13.3	22.6
First Overdose Age 31–42	23.9	23.1	26.7
First Overdose Age 43–52	24.4	24.5	24.3
First Overdose Age 53–90	36.2	39.2	26.5
Male	53.8	52.7	57.3
Female	46.2	47.3	42.7
Medicaid***	44.3	41.7	52.7
Non-Medicaid***	55.7	58.3	47.3
Enters Sample 2011	91.7	92.8	88.1
Enters Sample 2012	8.3	7.2	11.9
Sample Size	**1,755**	**1,343**	**412**

Source: Authors' calculations using HealthFacts RI.
Notes: The term "overdose" always refers to one that involved opioids. In most rows the values represent the percentage of the given group (either the entire sample or the subset with a specific number of overdoses) with the given characteristic. The bottom row shows the number of unique individuals in each group. "Number of Last 3 Months on MAT" shows the average number of the preceding three months in which an individual either filled a buprenorphine prescription or received methadone maintenance treatment within a given group. Opioid overdoses include those treated in an emergency department or in an inpatient setting. The sample consists of HealthFacts RI enrollees who had at least one nonfatal opioid overdose between April 2011 and May 2019 and at least three months of consecutive observations immediately following their first overdose. These individuals were selected from a larger sample of enrollees who were observed, at a minimum, in all months from January 2013 through December 2015 (excepting up to three months) and who did not switch between Medicaid and non-Medicaid insurance plans before January 2017. All sample members were at least 18 years of age at the time of their first overdose.
* "Receives MAT (Ever)" is defined as receiving methadone maintenance treatment or filling a buprenorphine prescription in at least one month among all of an individual's observations.
** "Opioid Use/Abuse Diagnosis (Ever, At Most)" is defined as having at least one observation with a diagnosis of either opioid use or opioid abuse, but never having a diagnosis of the more serious condition of opioid dependence. "Opioid Dependence Diagnosis (Ever)" is defined as having at least one observation with a diagnosis of opioid dependence. Other diagnosis-related variables are defined similarly by requiring at least one observation with the given diagnosis. The complete list of ICD-9 and ICD-10 codes used to identify all diagnoses, including opioid overdoses, can be obtained from the authors upon request.
*** Medicaid and non-Medicaid status are as of January 2015 for each individual.

Table 1 describes various characteristics of the sample members, considering the entire sample combined and then separating those with a single observed overdose from those with two or more observed overdose events. Just under half of all sample members received methadone or buprenorphine at least once, either before or after their first overdose. The share who received MAT at least once is significantly greater among the subsample who had at least two overdoses as opposed to just a single overdose—as seen in the first row of Table 1. While this fact would seem to point against the efficacy of MAT in reducing repeated overdose risk, most likely it means that eventual overdose repeaters had a more severe condition and were therefore more likely to be selected to receive MAT. For this reason, the regression analysis employs ever-MAT status as a control variable and examines the association between recent MAT treatment and repeated overdose risk.

Also, as seen in Table 1, overdose sample members are highly likely—80 percent or more, depending on the condition—to have been diagnosed with any of several medical conditions, including anxiety, depression, another substance use disorder, or another mental illness besides opioid use disorder (OUD), and more than one-third have been diagnosed with hepatitis C. The sample is not restricted to those who have been diagnosed with OUD, but more than 70 percent displayed a diagnosis of opioid dependence and about 6 percent had a less severe diagnosis of use or abuse at most. More than half of the sample members have on at least one occasion filled prescriptions in the same month for an opioid and an anti-anxiety drug (benzodiazepine), which are known to be highly dangerous when combined (Gudin et al. 2013). Regarding their demographic characteristics, more than half are male, and perhaps surprisingly, more than one-third had their first observed overdose at age 53 or older. About 44 percent had Medicaid insurance as of January 2015—compared with roughly one-fourth of all HealthFacts RI enrollees as of the same date.[36]

To estimate the association between recent treatment with either methadone or buprenorphine and the risk of repeated overdose, we employ regression models that include numerous control variables.[37] The main explanatory factor of interest is a measure of the recent frequency of MAT treatments, which we calculate as the number of months out of the three months immediately preceding the overdose in which the individual either received methadone maintenance treatment or filled a prescription for buprenorphine. For those who ever receive MAT, this variable can change over time, ranging from a minimum of zero to a maximum of three; for those who never receive MAT, the value is always zero. The average value of this variable (across person-by-month observations) is 0.5, which can be taken to mean that in the average observation a patient had received MAT in one of the preceding six months.

36 Based on how the overdose sample is constructed, those with Medicaid insurance as of January 2015 would have held Medicaid insurance in most of their observations, although they might have switched away from Medicaid starting in January 2017.

37 Specifically, we employ Cox proportional hazard models. Refer to the online Technical Appendix for details.

Other variables in the model include a set of indicators of diagnosis and treatment patterns that draw on all of a patient's observations: ever receiving MAT; ever being diagnosed with alcohol use disorder, a substance use disorder other than opioid use disorder, hepatitis C, any mental illness, depression, or anxiety; ever filling a high-dose opioid drug prescription (other than medications to treat OUD); ever filling both an opioid prescription and a benzodiazepine prescription in the same month; and ever receiving behavioral therapy. These factors aim to capture underlying aspects of an individual's health status that may result in persistent differences in repeated overdose risk. Two other fixed factors—gender and level of OUD diagnosis—are taken into account through a method called stratification.

In addition to these fixed characteristics, we include indicators of filling a high-dose opioid prescription in the current month, filling both an opioid and a benzodiazepine prescription in the current month, and the number of months out of the preceding three months in behavioral therapy.[38] The model also includes indicators of having Medicaid insurance (as opposed to a non-Medicaid plan such as Medicare or commercial insurance), of entering the HealthFacts RI sample in 2012 as opposed to 2011, and of the patient's age range as of their first overdose. The baseline age range pertains to those aged 18 through 30 at the time of their first opioid overdose.[39]

The results indicate that the risk of having a second overdose (at a given number of months after the first overdose) decreases with the number of MAT treatments in the preceding three months, controlling for all of the additional factors listed above. Among those ever receiving MAT, a patient treated with MAT in just one of the preceding three months is expected to face a 16 percent lower risk of repeated overdose compared with a patient with no MAT in the preceding three months, and a patient with MAT in all of the preceding three months would have a 41 percent lower risk. Consistent with some previous findings, filling prescriptions for both an opioid drug and a benzodiazepine drug in the same month predicts an increase in the risk of repeated overdose of 42 percent, although we have less confidence in this latter effect, statistically speaking, than we do in the association between recent MAT treatments and reduced overdose risk. Other characteristics associated with significantly elevated risk of repeated overdose include (ever) having an alcohol use disorder diagnosis and ever having a hepatitis C diagnosis, whereas being age 43 or older at the time of one's initial overdose predicts a significantly lower risk of repeated overdose.

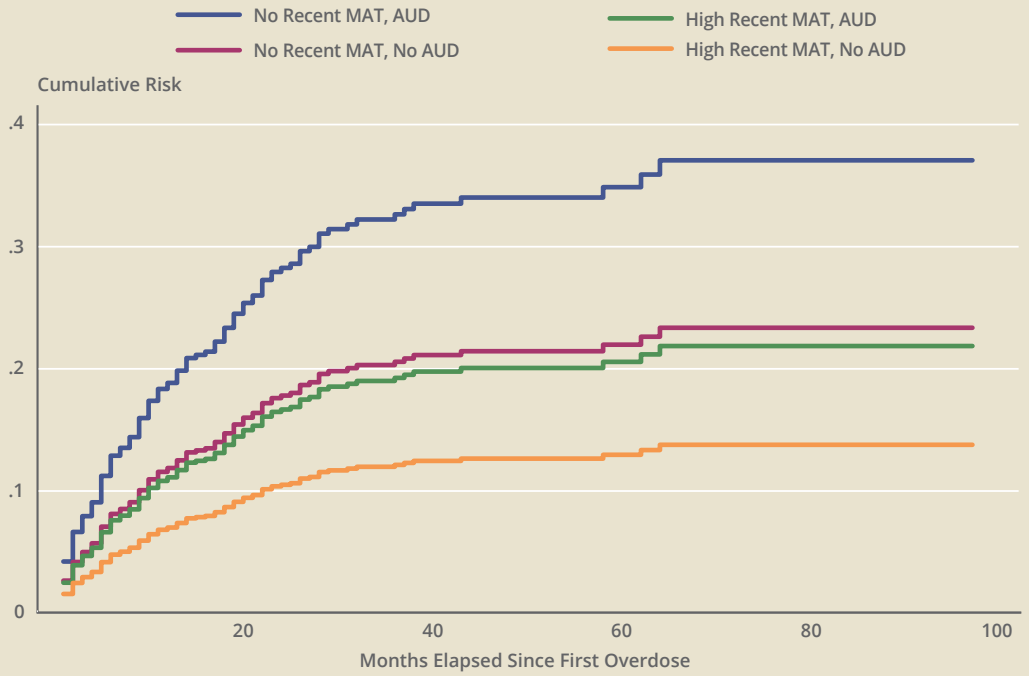
The model's results are illustrated in Figures 6 and 7, which show estimates of the cumulative risk of repeated overdose over elapsed time under a variety of assumptions. All of the curves in

38 Previous research finds that having or filling prescriptions for high-dose opioid drugs is associated with higher risk of repeated overdose (Larochelle et al. 2016), and that having prescriptions for both an opioid drug (regardless of dose) and a benzodiazepine drug at the same time predicts higher risk of any opioid overdose (Larochelle et al. 2019; Gudin et al. 2013).

39 The model also includes controls for the fiscal year in which a given observation occurred, to control for secular trends in either reporting or risks of repeated overdose not captured by other variables. These factors generally do not have significant effects on outcomes and are suppressed from all tables. See the online Technical Appendix for details.

Figure 6

Cumulative Risk of Second Overdose for Women By Selected Characteristics Nonfatal Opioid Overdose Sample



Source: Authors' calculations using HealthFacts RI.

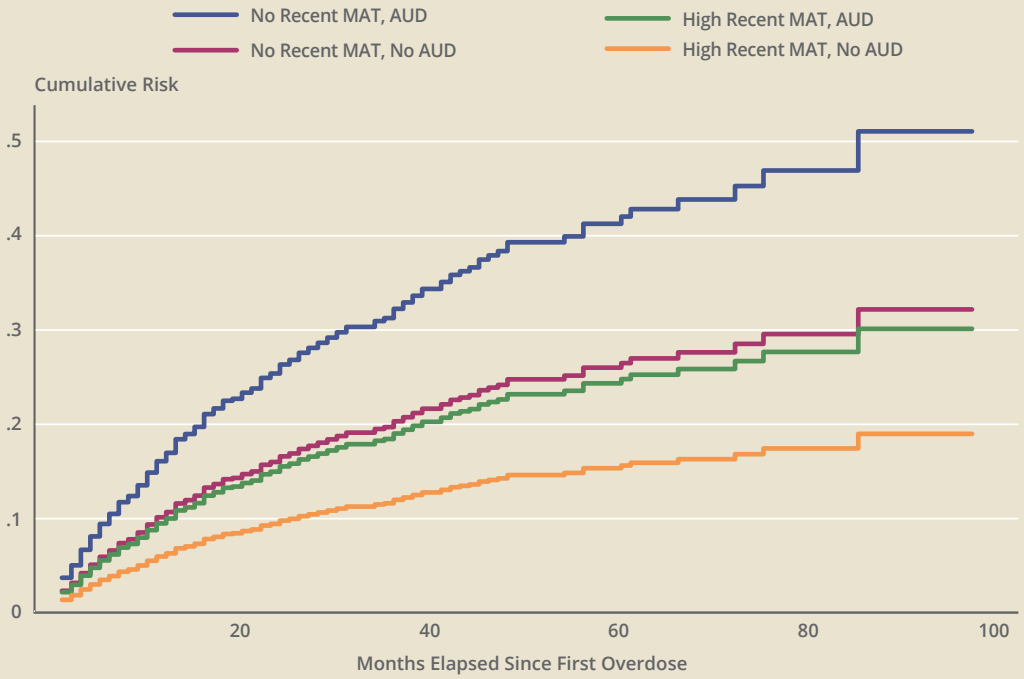
Notes: The term "overdose" always refers to one that involved opioids. See Table 1 for a description of the nonfatal opioid overdose sample. The cumulative risk at a given point on a given line represents the estimated probability that an individual with the given characteristics will have had a second overdose within the given amount of elapsed time after the first overdose, based on a Cox proportional hazard model. "No Recent MAT" means the individual did not receive either methadone or buprenorphine in any of the preceding three months, as of any amount of elapsed time. "High Recent MAT" means the individual received either methadone or buprenorphine in all three of the preceding months, as of any amount of elapsed time. "AUD" means the individual received a diagnosis of alcohol use disorder at least once among all their observations, and "No AUD" means the individual never had a diagnosis of alcohol use disorder. Aside from the characteristics that vary in the figure, characteristics were held constant at the following values: female, diagnosed with opioid dependence (ever), received either methadone or buprenorphine (ever), age at first overdose 18–30, and received no other diagnoses. See the online Technical Appendix for additional details.

Figure 6 pertain to a female patient with a diagnosis (ever) of opioid dependence and who received MAT at least once, but each individual curve makes different assumptions about the combination of alcohol use disorder status and recent number of MAT treatments. The horizontal axis represents months elapsed after the first overdose. In each curve the cumulative risk increases fairly steadily (at varying paces) within the first 30 months after the initial overdose and then becomes relatively flat thereafter (with the exception of the interval between 58 and 62 months).

Of the scenarios shown, the one involving the lowest cumulative risk pertains to the patient who is never diagnosed with alcohol use disorder and who received MAT in all three of the preceding three months. In contrast, a patient with alcohol use disorder who (as of any given month) has not received any MAT in the preceding three months experiences the highest levels of cumulative risk. The model predicts, for example, that there is a roughly 14 percent chance that the latter patient will have had a second overdose within 10 months of the first overdose and only a 5 percent chance that the former patient will have done the same. The two intermediate curves—which are nearly coincident—show that the effect of having alcohol use disorder on repeated overdose risk is roughly equivalent to the effect of having no recent MAT treatments. This offsetting effect means that any risk-lowering effects of MAT would be hard to detect if one were to compare

Figure 7

Cumulative Risk of Second Overdose for Men By Selected Characteristics Nonfatal Opioid Overdose Sample



Source: Authors' calculations using HealthFacts RI.

Notes: The term "overdose" always refers to one that involved opioids. See Table 1 for a description of the nonfatal opioid overdose sample. The cumulative risk at a given point on a given line represents the estimated probability that an individual with the given characteristics will have had a second overdose within the given amount of elapsed time after the first overdose, based on a Cox proportional hazard model. "No Recent MAT" means the individual did not receive either methadone or buprenorphine in any of the preceding three months, as of any amount of elapsed time. "High Recent MAT" means the individual received either methadone or buprenorphine in all three of the preceding months, as of any amount of elapsed time. "AUD" means the individual received a diagnosis of alcohol use disorder at least once among all their observations, and "No AUD" means the individual never had a diagnosis of alcohol use disorder. Aside from the characteristics that vary in the figure, characteristics were held constant at the following values: male, diagnosed with opioid dependence (ever), received either methadone or buprenorphine (ever), age at first overdose 18—30, and received no other diagnoses. See the online Technical Appendix for additional details.

patients without taking into account whether they have co-occurring alcohol use disorder.

Figure 7 shows the estimated cumulative risk of repeated overdose risk for men, under the same scenarios assumed for women in Figure 6. The curves for men differ in their overall shape from those estimated for women, in that risks increase more steadily over time as opposed to leveling off, and risk levels are generally higher for men for any amount of elapsed time. Based on how the model was estimated, however, the relative effects of the different risk factors on repeated overdose risk are equivalent to those seen among women.

These results suggest that individuals with more consistent recent MAT treatments experience substantial reductions in their repeated overdose risk. The model also shows that the repeated overdose risk profile is steepest in the first 12 months following an initial overdose, suggesting that early treatment intervention is important. Indeed, among overdose repeaters in our sample, 10 percent have their second overdose less than one month after their first, 25 percent have the second overdose within less than three months, and the median time lapse between the first and second overdoses is just over nine months.[40]

40 Separately, the overdose analysis was conducted on a sample that excluded all individuals who were ever enrolled in a health insurance plan operated by United Healthcare but was otherwise similar to the original nonfatal opioid overdose sample. The results obtained on that alternative sample are very similar to those reported here, both quantitatively and qualitatively. See Burke et al. (forthcoming) for details.

This suggestive evidence of a protective effect of MAT for overdose risk may not be causal, however. Patients do not receive MAT at random. For example, shocks such as a sudden job loss or death in the family may make it harder for the patient to maintain their treatment regime while simultaneously increasing their desire to abuse opioids. Conversely, patients experiencing high levels of social support during a given time period may be more likely to maintain MAT treatments and to have less desire to abuse drugs. Although the analysis attempts to control for such confounding factors indirectly using the available data, the controls are necessarily incomplete.

VIII. Associations between Enrollee Characteristics and Treatment with Buprenorphine or Methadone

The analysis above reinforces medical guidelines that endorse the use of methadone and buprenorphine to treat opioid use disorder (OUD). The next step is to identify factors that might increase or decrease the chances that an OUD patient will receive either of these medications, as this information can inform policies seeking to promote greater uptake of medication-assisted treatment (MAT) to improve patient outcomes. We accomplish this by conducting regression analysis that ensures the estimated association between any single factor and the treatment outcome is adjusted for differences in other relevant factors.[41] The analysis is restricted to the set of patients in the incumbent panel described above who have ever been diagnosed with opioid dependence.[42]

The data indicate that living in a high-poverty area and being female both reduce access to buprenorphine, while having Medicaid increases access to methadone.

The analysis draws on all of a patient's observations to determine outcomes and explanatory factors.[43] The outcome of interest is defined as being treated with methadone (or, separately, buprenorphine) in at least three separate calendar months. The set of predictive factors is the same for either outcome and consists of the following: the patient's sex, the year of the patient's first observation in the database, the patient's age group as of the first observation, having Medicaid insurance as opposed to non-Medicaid insurance,[44] living in a high-poverty Zip code,[45] and indicators of having a diagnosis (ever) of alcohol use disorder, substance use disorder (not including alcohol or opioids), depression, anxiety, mental illness (not including OUD), hepatitis C, and opioid overdose, respectively. We analyze treatment with methadone separately from treatment with buprenorphine because we find that these two outcomes differ in terms of how each is associated with the predictive factors.

41 For details of the regression models, see the online Technical Appendix.

42 Before imposing the incumbent panel restrictions and selecting those who have at least one observation with a diagnosis of opioid dependence, we exclude observations in which the individual was younger than 18, in which the Zip code was not in Rhode Island, and in which the medical insurance payer was either United Healthcare or an unknown payer.

43 By "all observations" we mean all observations that were not excluded in assembling the sample.

44 Age group and Medicaid insurance status are based on the patient's earliest observation in the database. The sample excludes individuals who switched between Medicaid and non-Medicaid plans before December 2016, such that Medicaid status as of the first observation will apply to most if not all of each patient's observations.

45 Using the American Community Survey, we define a Zip code as "high poverty" in a given year if 20 percent or more of the households had incomes at or below the federal poverty level in the given year. As each patient is observed in multiple periods and may move across Zip codes over time, a given patient is said to reside in a high-poverty Zip code if they lived in such a Zip code in more than half of their observations.

Table 2

Percentage of Sample with Selected Characteristics

Restricted Incumbent Panel and Subset with Opioid Dependence

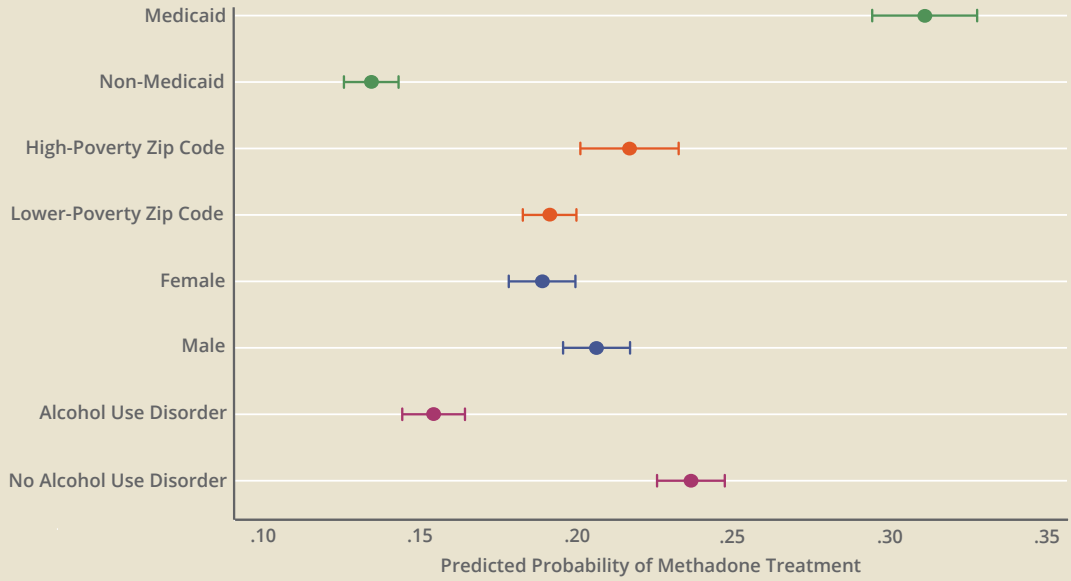
	All	Opioid Dependence (Ever)
Received Buprenorphine*	0.9	29.3
Received Methadone*	0.6	19.7
Received MAT*	1.3	42.7
Enters Sample 2011	92.5	90.5
Enters Sample 2012	7.5	9.5
Entry Age 18–44	34.6	52.8
Entry Age 45–64	36.8	40.8
Entry Age 65+	28.6	6.4
Medicaid	7.6	31.5
Non-Medicaid	92.4	68.5
Female	55.2	46.9
Male	44.8	53.1
Alcohol Use Disorder (Ever)	7.3	41.1
Opioid Overdose (Ever)	0.4	9.1
Hepatitis C (Ever)	1.6	18.4
Depression (Ever)	33.8	78.8
Anxiety (Ever)	41.7	81
Other Mental Illness (Ever)	42.1	85.1
Opioid Dependence (Ever)	3.1	100
Other Substance Use Disorder (Ever)	14.4	76.4
High-Poverty Zip Code (Most Months)	13.7	22.2
Sample Size	**288,331**	**8,951**

Source: Authors' calculations using HealthFacts RI.
Notes: The restricted incumbent panel consists of individuals who were observed, at a minimum, in most months (missing as many as three) from January 2013 through December 2015, who were at least age 19 as of January 2013, and who did not switch between Medicaid and non-Medicaid insurance plans between the date of their first observation and December 2016. The panel further excludes observations with United Healthcare insurance, observations with an unknown medical insurance carrier, out-of-state observations, observations with age under 18, and individuals with missing poverty indicators in more than half of their observations. The opioid dependence (ever) sample consists of individuals in the restricted incumbent panel who ever received an opioid dependence diagnosis. Characteristics followed by an asterisk (*) are defined as having received buprenorphine/methadone/any MAT, respectively, in three or more months. Entry age is an individual's age as of their first month in the sample. Medicaid and non-Medicaid status are as of January 2015 for each individual. All diagnosis-related variables, such as "Alcohol Use Disorder (Ever)," are defined as having at least one observation with the given diagnosis. "High-Poverty Zip Code (Most Months)" means that, for more than half of the months in which someone was observed, they resided in a Zip code in which 20 percent or more of households had incomes at or below the federal poverty level.

Column 2 of Table 2 shows the sample means of the outcomes and the predictive factors over the regression sample, along with sample means for the larger patient panel. Within the opioid dependence patient sample, just under 20 percent received methadone treatments in at least three separate months, and slightly more than 29 percent were on buprenorphine in at least three separate months. Almost 43 percent received at least one of these medications in three or more months, which means that some patients received both drugs, although not necessarily in

Figure 8

Predicted Probability of Receiving Methadone Treatment: Restricted Incumbent Panel



Source: Authors' calculations using HealthFacts RI.

Notes: Probabilities are based on a multivariate probit model of receiving methadone treatment in at least three separate months. Sample consists of patients in the restricted incumbent panel who were diagnosed with opioid dependence. See the online Technical Appendix for additional details. "High-Poverty Zip Code" means that, for more than half of the months in which someone was observed, they resided in a Zip code in which 20 percent or more of households had incomes at or below the federal poverty level. "Lower-Poverty Zip Code" means that the individual did not meet the criterion for "High-Poverty Zip Code." That is, for at least half of the months in which they were observed they resided in a Zip code in which fewer than 20 percent of households had incomes at or below the federal poverty level. "Alcohol Use Disorder" means the individual received a diagnosis of alcohol use disorder at least once among all their observations, and "No Alcohol Use Disorder" means the individual never had a diagnosis of alcohol use disorder.

the same month.[46] Women are underrepresented in the opioid dependence sample, as are older patients (those who entered the sample at age 65 or older). Members of the opioid-dependence sample are more likely to reside in a high-poverty Zip code and are more likely to have Medicaid insurance compared with the broader sample population. They are also much more likely to have any of the comorbid diagnoses of alcohol use disorder, other substance use disorder, hepatitis C, depression, anxiety, and other mental illness. For example, nearly 41 percent of patients diagnosed with opioid dependence also have a diagnosis of alcohol use disorder, compared with just over 7 percent in the broader sample, and 76 percent have been diagnosed with another substance use disorder, compared with only 14.4 percent in the larger sample. These differences in diagnosis rates may overstate the true differences in prevalence rates of these conditions, however, as patients diagnosed with opioid dependence may simply be more likely to have had those other conditions diagnosed.

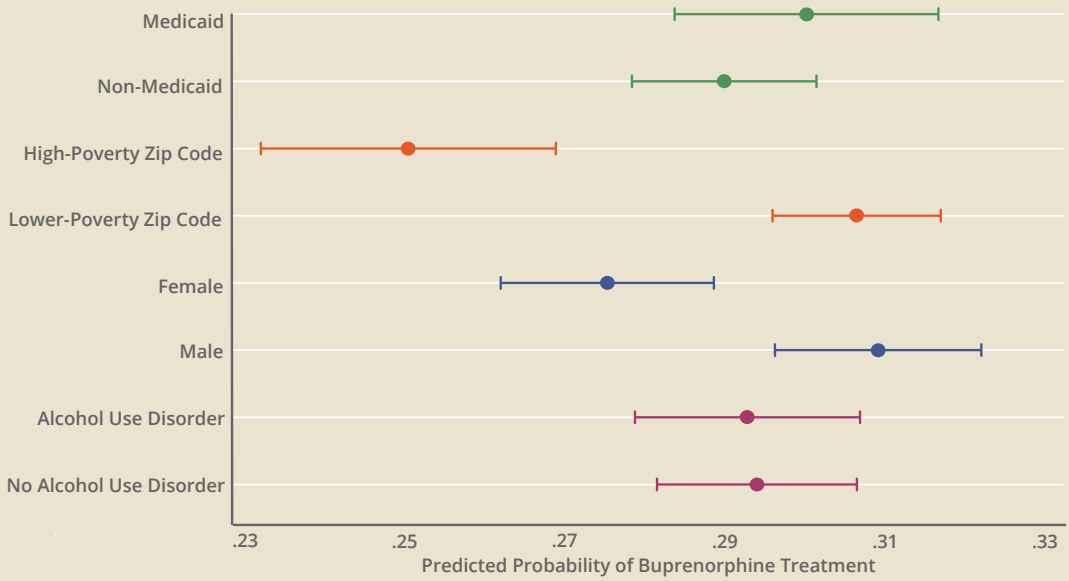
Figure 8 shows the average predicted chance of receiving methadone at selected values of characteristics as estimated by the regression model.[47] Opioid dependence patients on Medicaid

46 Although we do not have data for the United States that would be directly comparable to these MAT rates for Rhode Island, separate data sources indicate that OUD patients in Rhode Island are much more likely to receive MAT compared with the average OUD patient in the United States. According to the N-SSATS, in 2019 roughly 35 percent of all US patients treated for any substance use disorder received MAT, whereas in Rhode Island the comparable rate was more than 59 percent. See also Burke (2019).

47 For example, the average predicted probability of a Medicaid-insured patient receiving methadone is calculated as follows: A predicted probability of the outcome is generated for each patient in the sample assuming the patient has Medicaid insurance (regardless of their actual insurance) and setting all other characteristics at their actual values and applying the regression coefficients; the respective predicted probabilities are then averaged over all patients in the sample.

Figure 9

Predicted Probability of Receiving Buprenorphine Prescriptions: Restricted Incumbent Panel



Source: Authors' calculations using HealthFacts RI.

Notes: Probabilities are based on a multivariate probit model of receiving a buprenorphine prescription in at least three separate months. Sample consists of patients in the restricted incumbent panel who were diagnosed with opioid dependence. See the online Technical Appendix for additional details. "High-Poverty Zip Code" means that, for more than half of the months in which someone was observed, they resided in a Zip code in which 20 percent or more of households had incomes at or below the federal poverty level. "Lower-Poverty Zip Code" means that the individual did not meet the criterion for "High-Poverty Zip Code." That is, for at least half of the months in which they were observed they resided in a Zip code in which fewer than 20 percent of households had incomes at or below the federal poverty level. "Alcohol Use Disorder" means the individual received a diagnosis of alcohol use disorder at least once among all their observations, and "No Alcohol Use Disorder" means the individual never had a diagnosis of alcohol use disorder.

insurance are more than twice as likely to be treated with methadone compared with patients on non-Medicaid plans—the predicted methadone rate is roughly 32 percent among Medicaid patients and about 13 percent for non-Medicaid patients. Patients living in high-poverty Zip codes have a higher predicted chance of receiving methadone than do patients in Zip codes with lower poverty rates, by about 2 percentage points on average. Women are less likely than men to receive methadone, but by an expected margin of less than 2 percentage points. In addition, patients with comorbid alcohol use disorder face a much lower chance of receiving methadone compared with patients who don't have that condition—the expected rates for these two groups are 14 percent and 21 percent, respectively. The results offer a high level of confidence (95 percent or better) that these associations did not arise by chance.

Other factors associated with a higher expected chance of receiving methadone include having had an opioid overdose, a hepatitis C diagnosis, or a diagnosis of another substance use disorder. In contrast, belonging to an older age group, based on age at the time of a patient's first observation, is associated with having significantly lower chances of receiving methadone.[48]

The factors that predict buprenorphine treatment are in some cases similar to those observed for methadone but in other cases strikingly different; see Figure 9. Again, women are somewhat less likely to receive buprenorphine compared with men, and older initial-age observation in the sample also predicts a lower buprenorphine treatment rate. However, having Medicaid insurance

48 Differences in sample entry age ranges are good indicators of age differences at a given point in time, as most patients were first observed in April 2011 and all sample members had entered by December 2012.

does not predict any greater tendency to be treated with buprenorphine,[49] and patients in high-poverty Zip codes are less likely than patients in Zip codes with lower poverty rates to receive buprenorphine, all else being equal.

The sample was constructed so that each individual had a large number of observations over a similar time period, ensuring accurate measurement of the variables of interest and minimizing the potential influence of time trends in treatment patterns. However, the share of patients with Medicaid insurance in our sample is significantly lower than it would be in a sample that included people who entered after the Affordable Care Act–associated Medicaid expansion took effect in Rhode Island. Using a less restricted sample that includes those who entered after the Medicaid expansion took effect produces very similar results.[50]

The associations just described cannot necessarily be considered causal. For example, patients with Medicaid insurance are more likely to have incomes at or near the poverty level compared with non-Medicaid patients, and their individual income status might influence their treatment outcomes independently of the type of insurance they carry. Similarly, the associations between treatment propensities and living in a high-poverty Zip code may reflect the characteristics of patients living in such Zip codes rather than or in addition to any differences in physical proximity to treatment across Zip codes.

IX. Effectiveness of Policies to Expand Access to Buprenorphine

Two significant changes to federal policies governing the prescribing of buprenorphine were enacted in mid-2016, both with the goal of helping more opioid use disorder (OUD) patients gain access to buprenorphine. In late July of 2016, the US Congress passed the Comprehensive Addiction and Recovery Act (CARA), which enables nurse practitioners and physician assistants to obtain waivers to prescribe buprenorphine—previously only MDs and psychiatrists could get such waivers. In early August of 2016, the Substance Abuse and Mental Health Services Administration (SAMHSA) enacted a final rule that allows qualified incumbent prescribers to increase their maximum patient limit to 275 after gaining one year of experience treating 100 patients. (Refer to Box 3 for the details of those policies.) The former policy is aimed at increasing the number of buprenorphine providers, and the latter targets the number of patients served per provider—offering two channels for boosting the total number of patients treated with the drug. The analysis that follows seeks to determine whether, during the sample period, these policies delivered the intended effects, and whether either policy proved more important than the other in terms of helping to increase patients' access to buprenorphine in Rhode Island.[51]

Some top buprenorphine prescribers did increase their patient loads in response to the rule change and appear to have driven the increase in the aggregate number of patients served.

We focus on changes in prescribing activity on either side of the policy changes. Allowing for a one-month lag until the changes had any effects, we let the "post-policy" period start in September

49 There is a small positive coefficient on the Medicaid indicator, but we are not highly confident that the effect is actually greater than zero.

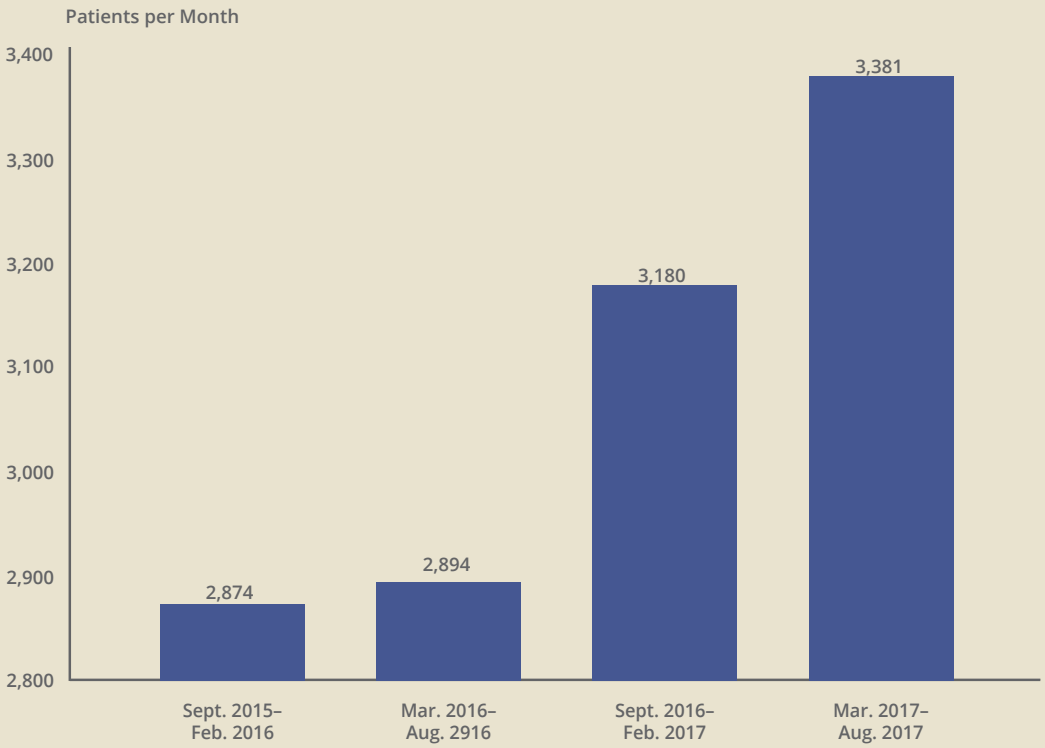
50 See Burke et al. (forthcoming) for details.

51 The SUPPORT Act of October 2018 further expanded the pool of eligible providers and allows for higher initial patient limits for qualified providers. However, our data set extends only through May 2019 and is missing some pharmacy claims and insurance enrollment information beginning in January 2018. Therefore, we are not in a position to evaluate the effects of the SUPPORT Act.

Figure 10

Six-month Average Buprenorphine Patient Loads

Rhode Island, September 2015–August 2017



Source: Authors' calculations using HealthFacts RI.

Notes: The patient load in a given month is the number of unique enrollees (aged 18 and older and residing in Rhode Island) who filled an allowable buprenorphine prescription in that month. A patient is counted at most once per month regardless of how many prescriptions they filled. An allowable prescription involves a buprenorphine formulation that is FDA-approved to treat opioid use disorder and for which the insurance claim was not denied. The prescriber on the claim must be an individual (not an organization) with a Rhode Island Zip code. The activity of one prescriber with excessive patient loads was excluded.

2016 and run through August 2017,[52] a total of 12 months, and we restrict the "pre-policy" period to September 2015 through August 2016, a 12-month period that includes the two months when these laws were enacted. Although the choice of these time intervals is somewhat arbitrary, considering symmetric time periods on either side of the policy changes is desirable for its own sake, and setting the first month of the pre-policy period as September 2015 should also help to minimize the influence of the Affordable Care Act and Medicaid expansion on pre-policy trends—the latter policies led to a surge in enrollments in 2014.

The number of buprenorphine patients per month fluctuated modestly during the 12-month pre-policy period, but on balance it was almost flat;[53] see Figure 10. In contrast, the monthly

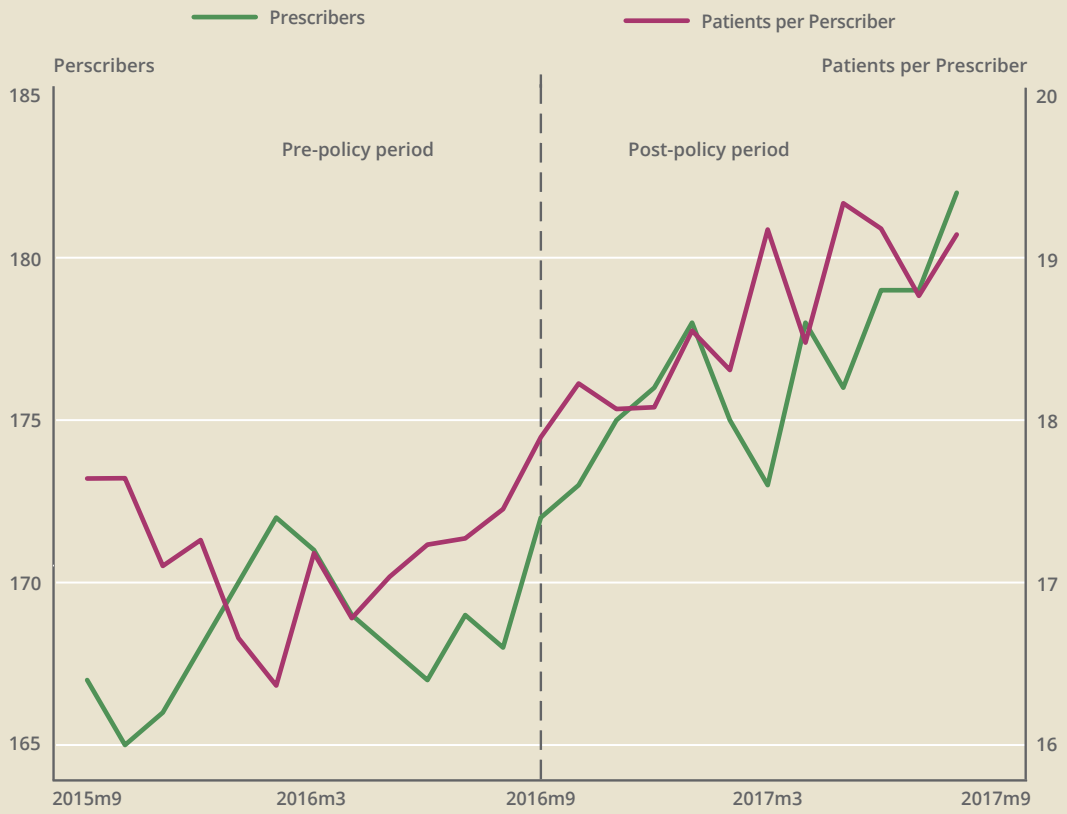
52 The pharmacy claims of Medicare fee-for-service patients are missing from the data from January 2018 forward, and as a result the trends in buprenorphine prescribing are also somewhat distorted from that same date onward.

53 Patients per month is calculated as the number of unique sample members aged 18 and older who filled an allowable buprenorphine prescription in the given month. An allowable prescription is defined as involving a buprenorphine formulation used to treat OUD (rather than pain or another condition), prescribed by a provider with a Rhode Island Zip code, and for which the insurance claim was not denied.

Figure 11

Buprenorphine Prescriber Stock and Average Number of Buprenorphine Patients per Prescriber

Rhode Island, Before and After Policy Enactment



Source: Authors' calculations using HealthFacts RI.

Notes: The vertical dashed line at September 2016 demarks the first month following changes in federal buprenorphine prescribing policies. The monthly prescriber stock includes only active prescribers: The prescriber must appear on a buprenorphine claim dated in that month or on claims dated both before and after the given month. Patients per prescriber is the ratio of the patient load to the prescriber stock. See Figure 10 *Notes* for the methods of counting the patient load per month.

patient load increased in September 2016 and trended upward throughout the post-policy period. The six-month average of patients per month increased by 286 patients in the first half of the post-policy period compared with the preceding six-month period, and it increased by an additional 200 patients in the second half of the post-policy period. More broadly, there were 400 additional buprenorphine patients in an average month in the post-policy period compared with an average month in the pre-policy period.[54]

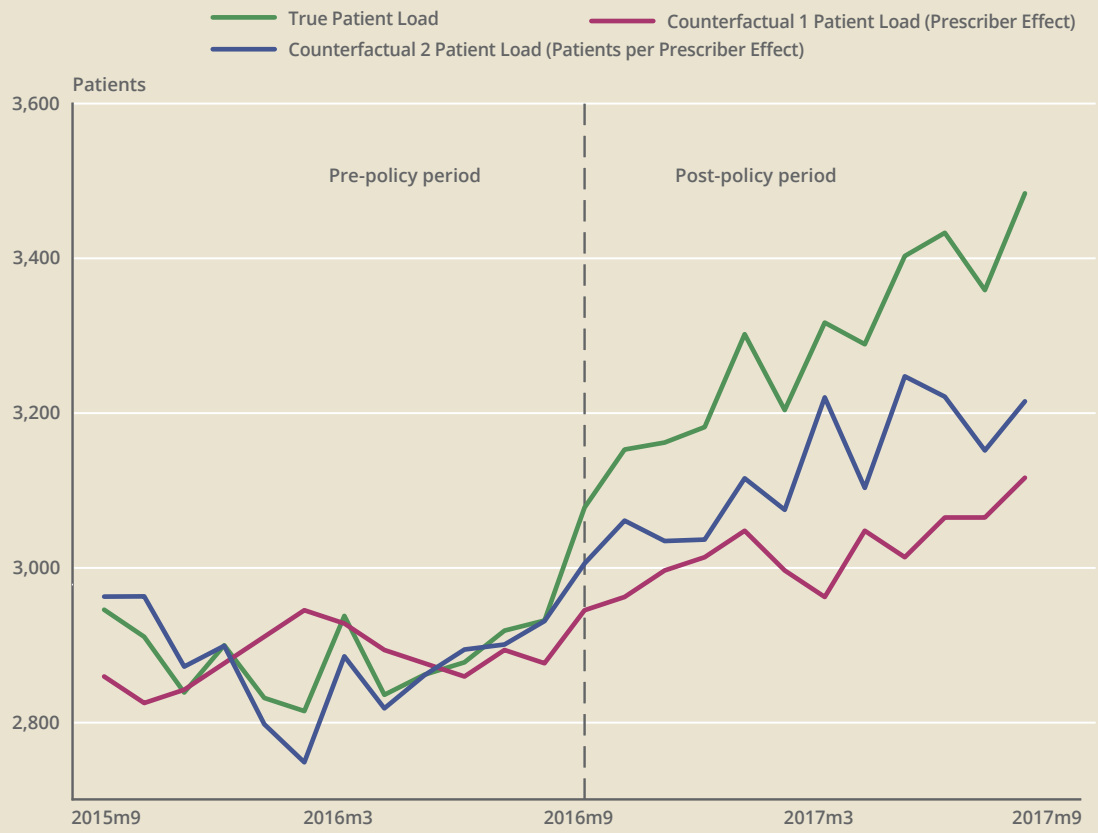
This significant increase in the number of buprenorphine patients reflects two underlying developments: The number of providers dispensing the drug increased in the post-policy period over the pre-policy period, as did the average number of patients served per prescriber, as seen in Figure 11. (The dashed vertical line in the figure marks September 2016, the start of the post-policy

54 Over a much longer pre-policy period spanning January 2012 through August 2016, patient loads increased significantly. Nonetheless, the average increase per month in the number of buprenorphine patients (scaled per total enrollees) is modestly greater in the (extended) post-policy period of September 2016 through December 2017 than in the extended pre-policy period of January 2012 through August 2016. See Burke et al. (forthcoming).

Figure 12

True Buprenorphine Patient Load and Counterfactual Buprenorphine Patient Loads

Rhode Island, Before and After Policy Enactment



Source: The vertical dashed line at September 2016 demarks the first month following changes in federal buprenorphine prescribing policies. See Figure 10 *Notes* for the method of calculating the patient load and Figure 11 *Notes* for the methods of calculating the prescriber stock and patients per prescriber. To calculate counterfactual 1, the value of patients per prescriber in a given month was multiplied by the fixed baseline value of the prescriber stock. The latter was set at 168, the average for September 2015–February 2016. To calculate counterfactual 2, the prescriber stock in a given month was multiplied by the fixed baseline value of patients per prescriber. The latter was set at 17, the average for September 2015–February 2016.

period.) These facts suggest that both policies achieved some measure of success, a finding that is explored in greater depth below. To assess the relative importance of each of these two margins—the stock of prescribers and patients per prescriber—in boosting patient loads, we construct two counterfactual scenarios. In the first scenario we calculate the patient counts (by month) that would have arisen with no change in the average number of patients per prescriber (from its pre-policy six-month average) while allowing the number of prescribers to evolve as observed. The changes in the patient load over time under this scenario reflect only the contribution of changes in the prescriber stock. To isolate instead the contribution of changes in the average number of patients per prescriber, we hold the prescriber stock fixed at its initial (pre-policy) six-month average and apply the observed monthly values of patients per prescriber.

Figure 12 shows the hypothetical patient load under each of these two scenarios, together with the actual patient load, for each month of the pre-policy and post-policy periods. Examining the trend in the patient load under a given counterfactual scenario (the blue line or the red line)

compared with the trend in the true patient load (the green line), one can discern roughly how much a given margin contributed to the actual increases in the patient load in the post-policy period—the more closely the counterfactual patient load tracks the actual patient load, the greater the contribution of the margin that varies in that counterfactual scenario.

The analysis reveals that increases in the average number of patients per prescriber account for more than half of the increases in the number of buprenorphine patients between the pre-policy and post-policy periods—the counterfactual patient load that is driven by changes in patients per prescriber (the blue line in Figure 12) is generally closer to the actual patient load than is the counterfactual that depends on changes in the number of prescribers (the red line). Comparing average outcomes in the first six months of the post-policy period (September 2016 through February 2017) with average outcomes in either the first half or the second half of the pre-policy period, we find that about 60 percent of the rise in the total number of patients receiving buprenorphine can be attributed to the uptick in the average number of patients served per prescriber, and about 40 percent owes to the increase in the number of prescribers. Regarding average outcomes in the second half of the post-policy period (March 2017 through August 2017) compared with either the first half or the second half of the pre-policy period, again roughly 60 percent of the increase in the patient load can be linked to an increase in patients per prescriber, and about 30 percent reflects an increase in the stock of prescribers—the remaining 10 percent reflects a residual interaction effect between the two margins.[55]

The increase along either margin was modest—the average number of patients per prescriber increased 8.4 percent, from roughly 17.2 in the pre-policy period to 18.6 in the post-policy period, while the average number of prescribers per month increased just 4.7 percent, from 168 to 176.[56]

Policy changes that allowed physician assistants and nurse practitioners to prescribe buprenorphine appear to have expanded treatment to previously underserved Rhode Island patients.

Recall that before August 2016 a prescriber could obtain permission to serve at most 100 patients, whereas starting in that month, per a SAMHSA rule change, some prescribers (depending on their existing patient limit and their experience or qualifications) became eligible to seek permission to serve as many as 275 patients. Because the average number of patients served per prescriber in our sample falls well below the threshold of 100 patients, both before and after the rule change of August 2016, it might appear that the rule change was not critical in facilitating the observed increase in that number.

However, examining changes in patient loads per prescriber at a more granular level suggests that some prescribers did take advantage of the increase in the patient limit and that high-volume prescribers were in fact the key drivers of the increase in the average number

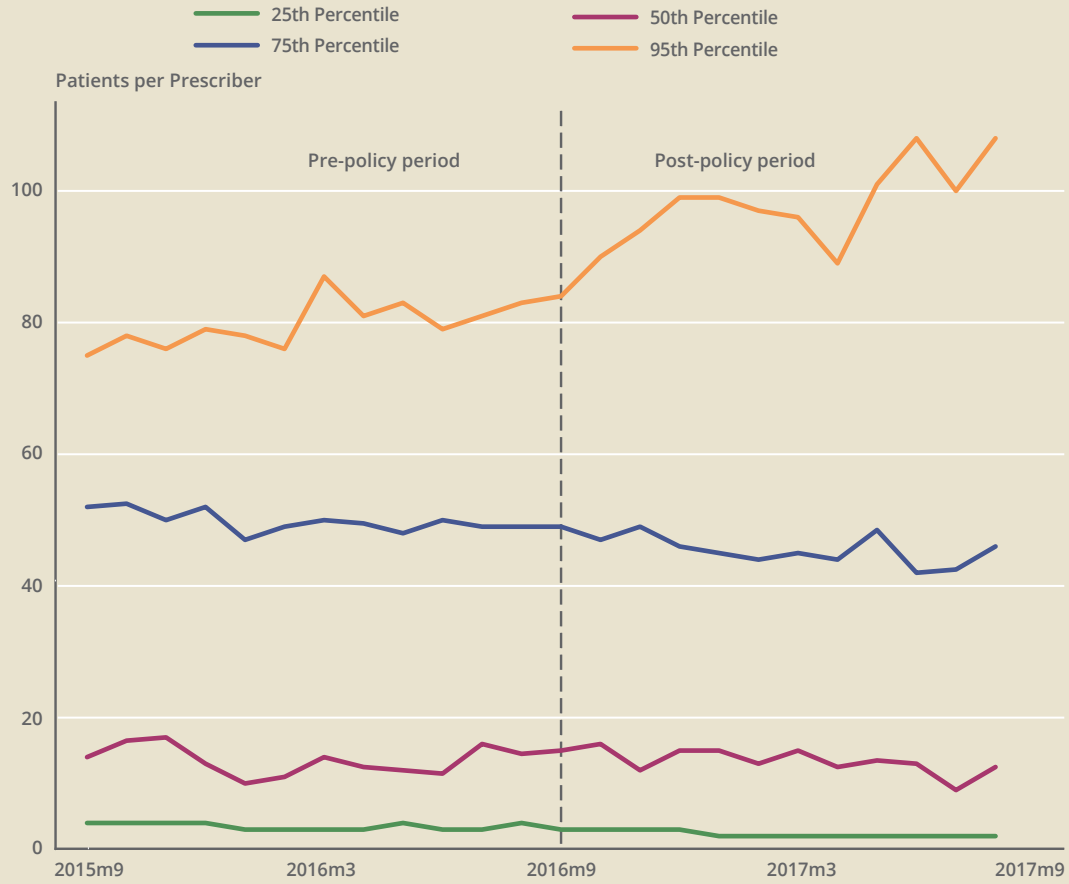
55 Some commercial insurers became exempt from reporting to HealthFacts RI in late 2015, which results in steep declines in the total number of enrollees in our sample in the first four months of 2016. To control for any distortions in trends caused by this issue, we replicate the counterfactual analysis after dropping from the sample all those who were ever enrolled in commercial medical insurance plans. The revised results are qualitatively robust—increases in the number of patients per prescriber still account for about 60 percent of the increases in patient loads between the post-policy and pre-policy periods.

56 The increase of 4.7 percent represents the increase in the exact 12-month average number of prescribers between the pre-policy and post-policy periods. Between the first half of the pre-policy period and the second half of the post-policy period, the average monthly prescriber stock rose by a slightly larger margin, from 168 to 178. Also, as the prescriber stock experiences both entry and exit over time, these changes in the number of active prescribers per month represent net changes that understate the gross number of new entrants over the period.

Figure 13

Percentiles of the Patients-per-Prescriber Distribution

Rhode Island, Before and After Policy Enactment



Source: Authors' calculations using HealthFacts RI.

Notes: The vertical dashed line at September 2016 demarks the first month following changes in federal buprenorphine prescribing policies. See Figure 11 *Notes* for the method of calculating the patients per prescriber in a given month. In calculating the monthly percentiles, we include only prescribers that wrote at least one prescription for buprenorphine in the given month.

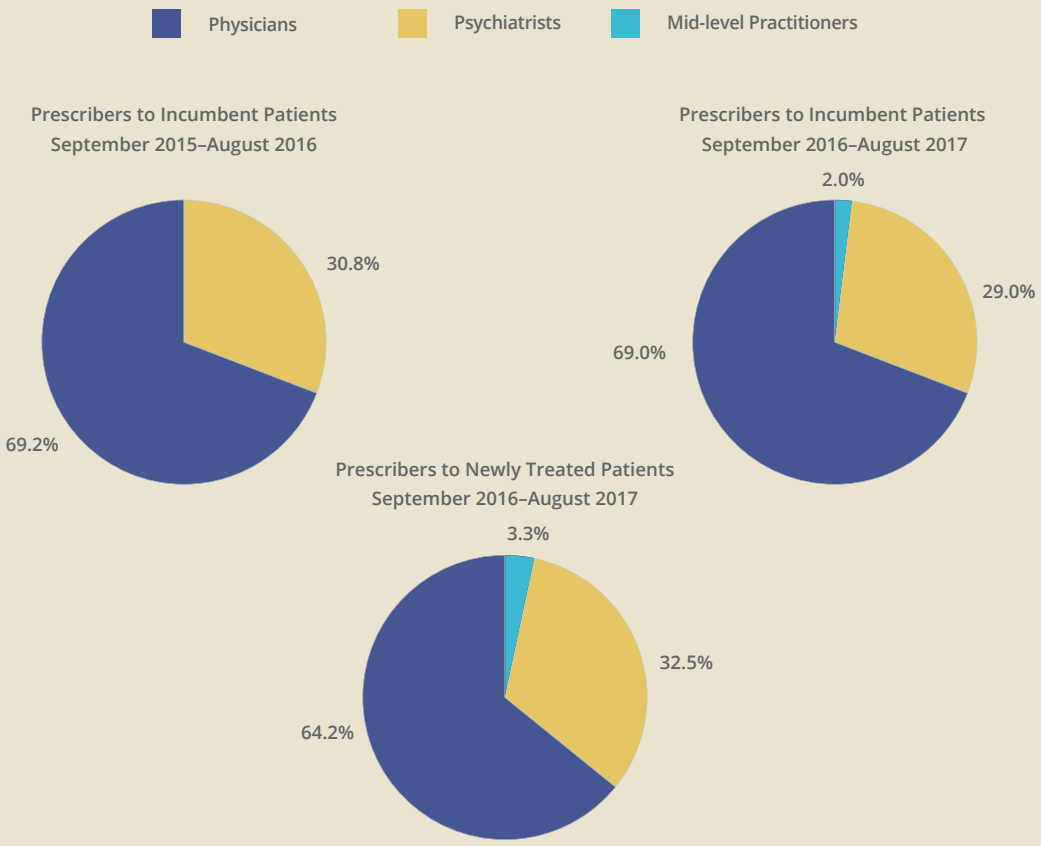
of patients served per prescriber. Figure 13 shows trends in various percentiles of the patients per prescriber distribution over the pre-policy and post-policy periods. Only the 95th percentile exhibits a noticeable upward trend, while the lower percentiles—including the median, or 50th, percentile—remain effectively flat or even decline across the periods. Most notably, the 95th percentile crosses the threshold of 100 patients per prescriber beginning in May 2017. That is, the top 5 percent of prescribers in terms of patient volume (a select group of fewer than 10 prescribers) as of the second half of 2017 served more than 100 patients apiece on average.

In sum, at least some top buprenorphine prescribers took advantage of the option to increase their patient loads in response to the rule change, and those actions appear to have had a pivotal role in driving the increase in the aggregate number of patients served, as the typical (for example, median) prescriber on net did not increase their patient load.

Figure 14

Composition of Credentials among Buprenorphine Prescribers

Rhode Island, Before and After Policy Enactment
By Patient's Initial Treatment Date



Source: Authors' calculations using HealthFacts RI.

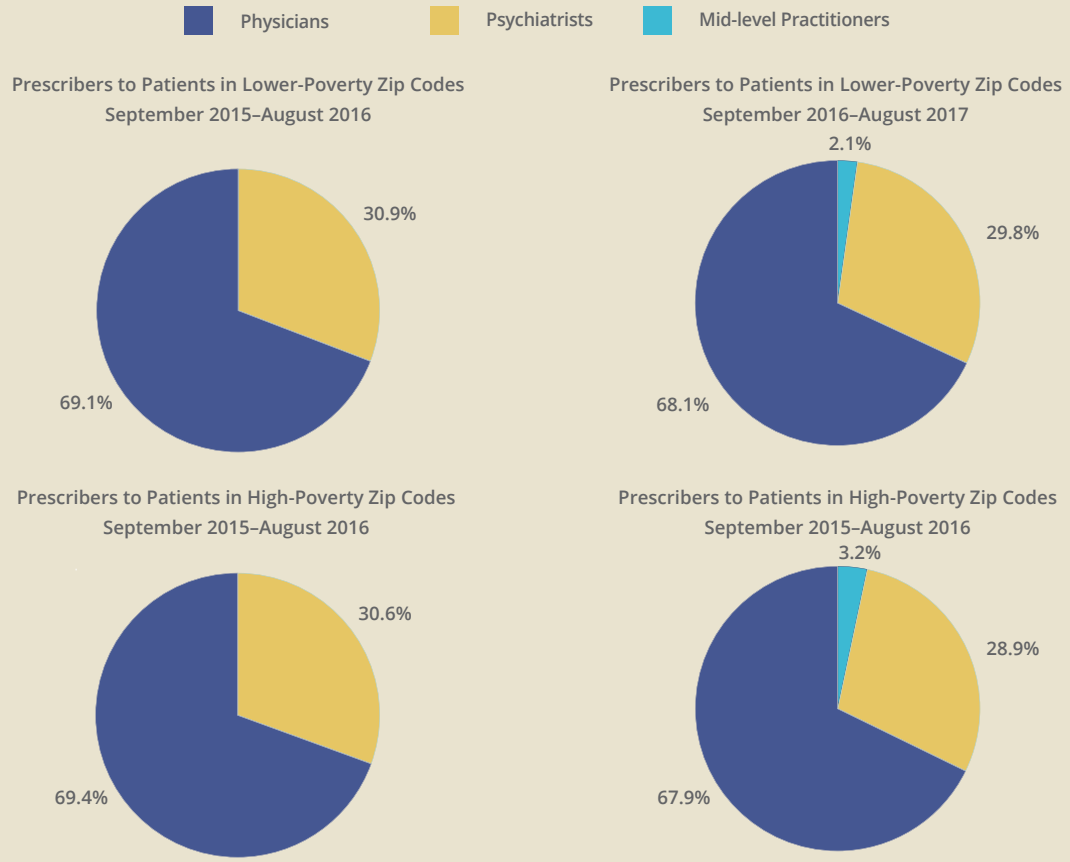
Notes: In a given pie, the universe of observations is the set of unique patient-provider pairs associated with the buprenorphine prescriptions observed in the given time period for patients with the relevant characteristic. A given slice represents the share of observations in which the provider has the relevant credential. Incumbent patients are those first observed with a buprenorphine prescription prior to September 2016, and newly treated patients are those who first receive buprenorphine in September 2016 or later. The category of physicians includes non-psychiatrists with either an MD degree (medical doctor) or DO degree (doctor of osteopathic medicine). Mid-level practitioners include physician assistants and nurse practitioners.

Even though our data indicate that there was only a modest increase in the number of buprenorphine prescribers in Rhode Island following the passage of CARA—the law that enabled physician assistants and nurse practitioners (so-called mid-level practitioners) to prescribe the drug—the policy appears to have been important in helping to expand buprenorphine prescribing to previously underserved patients or areas. Figure 14 shows the distribution of provider types among patient-provider pairs in the post-policy period, among incumbent patients—those who received buprenorphine before September 2016—and among new patients—those who first received buprenorphine in the post-policy period. Mid-level (or "low credential") practitioners, who effectively had zero market share in the pre-policy period, achieved a significant market share, among incumbent patients as well as new patients. However, they achieved a larger market share

Figure 15

Composition of Credentials among Buprenorphine Prescribers

Rhode Island, Before and After Policy Enactment
By Poverty Status of Patient's Zip Code



Sources: Authors' calculations using HealthFacts RI and the American Community Survey.

Notes: In a given pie, the universe of observations is the set of unique patient-provider pairs associated with the buprenorphine prescriptions observed in the given time period for patients with the relevant characteristic. A given slice represents the share of observations in which the provider has the relevant credential. Lower-poverty Zip codes are those in which fewer than 20 percent of the households had incomes at or below the federal poverty level in the given year, and high-poverty Zip codes are those in which 20 percent or more of the households had poverty-level or lower incomes in the given year. The category of physicians includes non-psychiatrists with either an MD degree (medical doctor) or DO degree (doctor of osteopathic medicine). Mid-level practitioners include physician assistants and nurse practitioners.

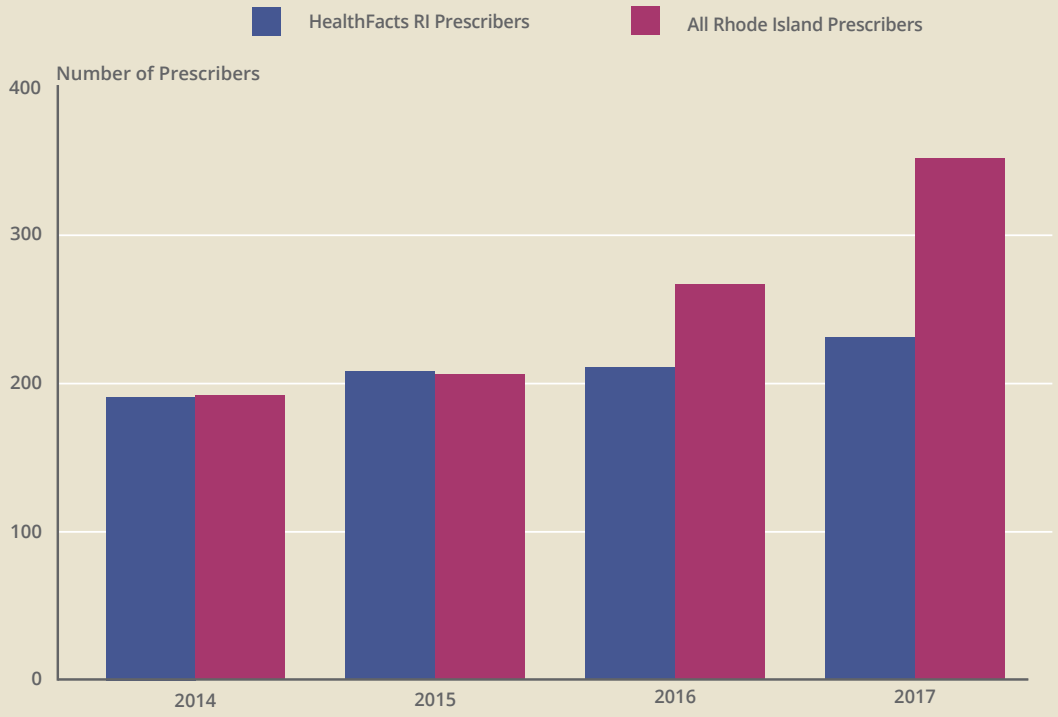
among new patients, suggesting that these newly eligible providers may have succeeded in reaching patients who previously had difficulty accessing a buprenorphine provider.

Furthermore, as seen in Figure 15, in the post-policy period, the newly eligible providers achieved a greater market share in high-poverty Zip codes than in lower-poverty Zip codes, suggesting that these new providers may have enabled increased access to buprenorphine for patients residing in high-poverty areas. Recall that the analysis in Section VIII found that, on average from 2011 through 2018, such patients were significantly less likely to be treated with buprenorphine compared with patients in lower-poverty Zip codes.

One issue worthy of further investigation is whether some providers with waivers to prescribe buprenorphine may not actually use their prescribing privileges or may not accept patients who

Figure 16

Annual Buprenorphine Prescribers
HealthFacts RI vs. All Rhode Island Prescribers



Sources: Authors' calculations using HealthFacts RI and Rhode Island Department of Health.

Notes: "HealthFacts RI Prescribers" in a given year consists of prescribers associated with at least one buprenorphine prescription observed in the database in that year. "All RI Prescribers" refers to the total number of waivered Rhode Island prescribers in the state in a given year.

intend to use health insurance to pay for the drug. As seen in Figure 16, in either 2014 or 2015 the number of unique Rhode Island prescribers of buprenorphine observed in our data coincides nearly exactly with the official Rhode Island number reported for the same year, but in 2016 and 2017 our numbers fall short—in 2017 we observe about 230 active prescribers, whereas the state lists 350 prescribers. The official numbers are based on observing waiver status directly, whereas our own counts are based on whether a provider wrote a buprenorphine prescription for at least one patient in our data set during the year.[57] Therefore, these patterns suggest that in 2014 and 2015 all waivered providers were active prescribers to insured patients, but that in 2016 and 2017 significant numbers of waivered providers either wrote no prescriptions or wrote prescriptions only to patients who paid out of pocket for the drug or who were enrolled in plans that are exempt from reporting to HealthFacts RI.[58] Based on any of those reasons, the data suggest that access to buprenorphine might be less than what is indicated by the official tally of waivered prescribers.

Furthermore, in following prescribers over time we find that the rate of apparent exit of

57 We observe the Zip code of the treatment address reported by each prescriber, and we include only those with Rhode Island Zip codes in our counts.

58 Because some plans observed before 2016 became exempt in late 2015, the decreased coverage of HealthFacts RI relative to insured Rhode Islanders may account for some of the apparent inactivity of buprenorphine prescribers in our data beginning in 2016. However, these were mostly medical plans, not pharmacy plans, and patients with exempt medical plans continue to exhibit pharmacy claims beyond 2016.

prescribers—defined by an indefinite hiatus in prescribing beyond a certain date—increased in 2016 and 2017 compared with earlier years. Nearly all of the prescribers in our data that ceased prescribing buprenorphine beyond a certain date nonetheless continued to prescribe other medications within the succeeding year, which means that they continued to serve patients with insurance plans reporting to HealthFacts RI, but only to prescribe drugs other than buprenorphine. Separate research finds that, of prescribers listed in SAMHSA's buprenorphine treatment locator in 2019 and practicing in any of 10 states including Rhode Island, 30 percent could not be reached by phone after repeated attempts, more than one-quarter of those that were contacted had stopped prescribing buprenorphine, and just 76 percent of those that were still prescribing accepted private insurance and only 63 percent accepted Medicaid insurance.[59] These independent findings suggest that the apparent inactivity of buprenorphine providers in our sample is not merely a shortcoming of the data but instead reveals actual lapses in treatment capacity.

X. Policy Implications

Our results indicate that individuals adhering recently to medication-assisted treatment (MAT) experience significant reductions in their risk of having a second opioid overdose following an initial (nonfatal) overdose. Although it is possible that the association is not causal, the finding appears to support the effectiveness of MAT in Rhode Island, and it agrees with similar findings from previous studies that use data from other geographic contexts (Larochelle et al. 2018; Pierce et al. 2015). Furthermore, the results are consistent with a much wider body of research, including randomized clinical trials, indicating that MAT promotes abstinence from illicit opioid use and reduces other health risks such as HIV (Connery 2015). The results also offer support for the policy recommendation that MAT be initiated immediately following an opioid overdose, in the hospital if possible because emergency department visits may be the only point of medical care for some patients. Initiation of buprenorphine treatment in hospital settings has proven to be safe, effective, and cost-effective (Jaeger and Fuehrlein 2020). In 2019, Massachusetts became the first state in the country to require hospitals to offer MAT to treat opioid use disorder (OUD) in addition to treating the health complications in the ER.[60] Outside of Massachusetts the policy has been adopted on a hospital-by-hospital basis, and it is estimated that only 27 percent of hospitals nationwide offer this option.

Findings related to repeated overdose risk emphasize the need to help patients stay on MAT rather than merely helping them to initiate treatment.

Our findings related to repeated overdose risk also emphasize the need to help patients stay on medications for OUD rather than merely helping them to initiate treatment. In Rhode Island, a 2016 law made the state the first in the nation to require discharge plans for all patients arriving at a hospital due to an overdose. The discharge plans involve scheduling follow-up appointments and connecting patients with treatment programs or providers offering MAT, despite the state not requiring hospitals to offer MAT immediately after an overdose. The transition out of the hospital into the community has proven to be a critical time for treatment, and discharge plans and follow-up appointments are beneficial to longer-term treatment adherence.[61] Although communication

59 See Lila Flavin and J. Wesley Boyd, "A Government Database Is Supposed to Help People Seeking Treatment for Opioid Addiction. It Often Doesn't," *STAT News*, January 9, 2020; and Flavin et al. (2020).

60 See Martha Bebinger, "Now Mandated to Offer Meds for Opioid Addiction in the ER, Mass. Hospitals Get 'How-To' Guidelines," WBUR, January 7, 2019.

61 For details, see Rhode Island Department of Health, Department of Behavioral Healthcare, Developmental Disabilities and Hospitals, "Levels of Care for Rhode Island Emergency Departments and Hospitals for Treating Overdose and Opioid Use Disorder," March 2017.

across providers is key to facilitating proper substance abuse treatment after an overdose, the sensitive nature of an overdose may inhibit such communication.

Policies that have been proposed to facilitate compliance with methadone treatment in particular include relaxing restrictions on take-home doses, deploying mobile methadone vans, and establishing "medication-only" sites. The second and third options would face fewer regulatory requirements compared with full-service opioid treatment programs (OTPs)—for example, medication-only units would not be required to offer behavioral therapy—and so would have much lower start-up and operating costs than OTPs. Such policies are seen as helping patients stay on methadone once a treatment program has been established at a full-service OTP.[62] Accordingly, policymakers might work to enhance the accuracy of treatment location information in order to better assess which communities are underserved and to help patients connect with active prescribers that are located close to where they live.

Our findings on patterns in buprenorphine prescribing support the view that raising patient limits can enable select prescribers to serve more patients and as a result expand the total patient pool. However, further increases in patient limits are likely to be less effective at the margin, as it is unlikely that an individual prescriber can accommodate more than 275 buprenorphine patients at a time. In Rhode Island at least, the overwhelming majority of prescribers serve far fewer than 100 patients, and we estimate that the typical prescriber in 2017 probably served about 18. This is after we inflate our estimate to account for the fact that our data do not capture all buprenorphine patients in Rhode Island, and after we omit formerly active prescribers that appear to have ceased prescribing beyond a certain date.

Protecting access to health insurance will continue to be an important component of any strategy for maintaining and expanding access to evidence-based treatments.

Research on other states also finds that most providers have caseloads far below their existing patient limits (Thomas et al. 2017). Vermont's hub-and-spoke treatment model for OUD has proven effective at increasing patient density per buprenorphine prescriber (Brooklyn and Sigmon 2017). Adapting that model could mean creating formal links between individual buprenorphine prescribers and an OTP "hub" that would offer guidance from highly credentialed, experienced practitioners. As discussed in Box 4, the Centers of Excellence OTPs in Rhode Island already serve as a resource for other community-based health-care providers treating OUD patients, but relationships between prescribers and hubs tend to be established on an ad hoc basis, and not all individual practitioners in Rhode Island are formally tied with a hub.

Our analysis of provider credentials reveals that the 2016 Comprehensive Addiction and Recovery Act (CARA), by enabling nurse practitioners and physician assistants to prescribe buprenorphine, may have helped more patients in high-poverty Zip codes gain access to the drug. Some believe an effective next step would be the expansion of prescribing privileges to pharmacists due to their proximity to patients.[63] This would be particularly useful in geographic areas with few waivered providers. The challenge of uptake could be significant, however, as some pharmacists in rural areas do not even stock buprenorphine due to a combination of regulatory hurdles from the status of buprenorphine on opioid monitoring systems in prescription drug monitoring databases and stigma against the patients on MAT. As a result, other proposed policy changes

62 See also Lila Flavin and J. Wesley Boyd, "A Government Database Is Supposed to Help People Seeking Treatment for Opioid Addiction. It Often Doesn't," *STAT News*, January 9, 2020.

63 See Loren Bonner, "HHS Expands Buprenorphine MAT Program," *Pharmacy Today*, August 9, 2016.

at the pharmacy level include the removal of buprenorphine from opioid monitoring systems, increased training for pharmacists around MAT, or mandates requiring stocking and supplying the medications (Cooper et al. 2020; Thornton et al. 2017).

Calls to expand prescribing privileges to pharmacists have been reinforced during the COVID-19 pandemic. Canadian and Australian pharmacists have prescribing privileges, and both countries have higher rates of MAT uptake by individuals with OUD. The proximity of community pharmacists to patients could be particularly useful during efforts to reduce travel, with more than 90 percent of the US population within two miles of a retail pharmacy (Cochran et al. 2020).

Another policy dimension that has gained considerable interest recently is the expansion of telemedicine to increase uptake of MAT. Telemedicine options have been expanding for years. The federal Substance Use Disorder Prevention that Promotes Opioid Recovery and Treatment (SUPPORT) for Patients and Communities Act of 2018 expanded reimbursements for telehealth for all Medicare patients as opposed to just Medicare patients in rural areas, and it encouraged such practices in the case of Medicaid. In June 2019, one of the largest providers of MAT in Rhode Island began offering telehealth video conferencing options in an attempt to remove some of the barriers to buprenorphine treatment, including stigma and transportation.[64] In March of 2020, in response to challenges in accessing treatment during the onset of the COVID-19 pandemic, the federal government suspended a law that required patients to have an in-person visit with a health-care provider before they could be prescribed MAT. Through the end of the declared public health emergency, patients are temporarily able to initiate treatment over the phone without in-person or video appointments.[65] Telehealth-delivered MAT was found to be effective in small-scale studies before the pandemic, and patients were more likely to remain in treatment uninterrupted (Ho and Argáez 2018). Further evidence is needed to understand patient outcomes in larger samples and for those initiating treatment via telehealth.

In addition to the recent relaxation of telehealth regulations, the volume of medications—including both methadone and buprenorphine—that patients are able to take home was expanded during the pandemic. This shift prioritizes the goal of retaining patients in treatment for OUD over the risks of misuse and diversion of the medications. While approved as a temporary measure occasioned by the pandemic, this policy experiment could lead to longer-lasting changes in allowed take-home doses moving forward, if it is shown that the revised rules increased treatment retention without resulting in substantial increases in misuse and diversion (del Pozo and Rich 2020). Also, officials in Burlington, Vermont, and Philadelphia, Pennsylvania, recently announced they would not enforce penalties for the possession of diverted buprenorphine, on the rationale that some people are using diverted supplies to self-treat in lieu of going to a doctor and risking infection with COVID-19 (del Pozo, Krasner, and George 2020).

Rhode Island has made much progress in helping a large share of patients to access high-quality treatment for OUD, including MAT. At the same time the state continues to struggle with elevated overdose rates. Although this combination of facts might seem discouraging, our findings suggest that in Rhode Island, MAT appears to be working to significantly reduce overdose risk, provided patients have taken the medications recently. In sum, the evidence argues strongly for policies that would focus on improved treatment retention and not just initiation.

64 See G. Wayne Miller, "Program Offers Teleconferencing to Treat Substance-abuse Disorders," *Providence Journal*, June 24, 2019; and CODAC Behavioral Healthcare, "CODAC Behavioral Healthcare and Thundermist Health Center Deploy Technology to Expand Access to Treatment Amid Opioid Crisis," June 17, 2019.

65 For full directive, see US Department of Justice, Drug Enforcement Administration, Diversion Control Division website, "Electronic Prescriptions for Controlled Substances."

References

American Psychiatric Association. 2013. *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Washington, DC.

American Society of Addiction Medicine. 2017. "Billing and Coding: Medication-Assisted Treatment." American Society of Addiction Medicine.

American Society of Addiction Medicine. 2018. "Public Policy Statement on Prescription Drug Monitoring Programs (PDMPs)" *American Society of Addiction Medicine.* April 11, 2018.

Autor, David. 2014. "Skills, Education, and the Rise of Earnings Inequality among the 'Other 99 Percent.'" *Science* 344(6186): 843–851. DOI: 10.1126/science.1251868

Barocas, Joshua A., Laura F. White, Jianing Wang, Alexander Y. Walley, Marc R. LaRochelle, Dana Bernson, Thomas Land, Jake R. Morgan, Jeffrey H. Samet, and Benjamin P. Linas, 2018. "Estimated Prevalence of Opioid Use Disorder in Massachusetts, 2011–2015: A Capture–Recapture Analysis." *American Journal of Public Health* 108: 1675–1681. https://doi.org/10.2105/AJPH.2018.304673

Brooklyn, John R. and Stacey C. Sigmon. 2017. "Vermont Hub-and-Spoke Model of Care for Opioid Use Disorder: Development, Implementation, and Impact." *Journal of Addiction Medicine*, *11*(4): 286–292. https://doi.org/10.1097/ADM.0000000000000310

Burke, Mary A. 2019. "Access to Medication-Assisted Treatment for Opioid Use Disorder: Is Rhode Island Different, and Why?" Federal Reserve Bank of Boston Current Policy Perspectives No. 19-2.

Burke, Mary A., Katherine Carman, J. Frank Wharam, Hefei Wen, and Hao Yu. Forthcoming. "Who Gets Medication-assisted Treatment for Opioid Use Disorder and Does It Reduce Overdose Risk? Evidence from the Rhode Island All-payer Claims Database." Research Department Working Papers. Boston, MA: Federal Reserve Bank of Boston.

Burns, Rachel M., Rosalie L. Pacula, Sebastian Bauhoff, Adam J. Gordon, Hollie Hendrikson, Douglas L Leslie, and Bradley D. Stein. 2016. "Policies Related to Opioid Agonist Therapy for Opioid Use Disorders: The Evolution of State Policies from 2004 to 2013." *Substance Abuse* 37(1): 63–69. doi:10.1080/08897077.2015.1080208

Choo, Christie. 2009. "Medications Used in Opioid Maintenance Treatment." *US Pharmacist* 34(11): 40–53.

Clemans-Cope, Lisa, Victoria Lynch, Marni Epstein, and Genevieve Kenney. 2017. "Medicaid Coverage of Effective Treatment for Opioid Use Disorder: Trends in State Buprenorphine Prescriptions and Spending since 2011." Urban Institute Research Report. June 8, 2017.

Cochran, Gerald, Julie Bruneau, Nicholas Cox, and Adam J. Gordon. 2020. "Medication Treatment for Opioid Use Disorder and Community Pharmacy: Expanding Care during a National Epidemic and Global Pandemic." *Substance abuse* 41(3): 269–274. https://doi.org/10.1080/08897077.2020.1787300

Connery, Hilary Smith MD. 2015. "Medication-Assisted Treatment of Opioid Use Disorder." *Harvard Review of Psychiatry* 23(2): 63–75. doi: 10.1097/HRP.0000000000000075

Cooper, Hannah LF, David H. Cloud, Patricia R. Freeman, Monica Fadanelli, Travis Green, Connor Van Meter, Stephanie Beane, Umedjon Ibragimov, and April M. Young. 2020. "Buprenorphine Dispensing in an Epicenter of the U.S. Opioid Epidemic: A Case Study of the Rural Risk Environment in Appalachian Kentucky." I*nternational Journal of Drug Policy*. https://doi.org/10.1016/j.drugpo.2020.102701

del Pozo, Bandon and Josiah D. Rich. 2020. "Revising Our Attitudes towards Agonist Medications and Their Diversion in a Time of Pandemic." *Journal of Substance Abuse Treatment* 119. https://doi.org/10.1016/j.jsat.2020.108139

del Pozo, Brandon, Lawrence S. Krasner, and Sarah F. George. 2020. "Decriminalization of Diverted Buprenorphine in Burlington, Vermont and Philadelphia: An Intervention to Reduce Opioid Overdose Deaths." *The Journal of Law, Medicine & Ethics* 48(2): 373–375. https://doi.org/10.1177/1073110520935353

Department of Health and Human Services. 2001. "Opioid Drugs in Maintenance and Detoxification Treatment of Opiate Addiction." Federal Register 66: 2076-4102. Accessed October 18, 2019.

Diaper, A. M., F. D. Law, and J. K. Melichar. 2014. "Pharmacological Strategies for Detoxification." *British Journal of Clinical Pharmacology* 77(2): 302–314.

Evans, Elizabeth A., Yuhui Zhu, Caroline Yoo, David Huang, and Yih-Ing Hser. 2019. "Criminal Justice Outcomes over 5 Years after Randomization to Buprenorphine-Naloxone or Methadone Treatment for Opioid Use Disorder." *Addiction* 114: 1396–1404. https://doi.org/10.1111/add.14620

Faul, Mark, Michele Bohm, and Caleb Alexander. 2017. "Methadone Prescribing and Overdose and the Association with Medicaid Preferred Drug List Policies—United States, 2007–2014." *MMWR Morb Mortal Wkly Rep* 2017(66): 320–323. http://dx.doi.org/10.15585/mmwr.mm6612a2external icon

Flavin, Lila, Monica Malowney, Nikhil A. Patel, Michael D. Alpert, Elisa Cheng, Gaddy Do Noy, Sarah Samuelson, Nina Sreshta, and J. Wesley Boyd. 2020. "Availability of Buprenorphine Treatment in the 10 States with the Highest Drug Overdose Death Rates in the United States." *Journal of Psychiatric Practice* 26(1): 17– 22. doi: 10.1097/PRA.0000000000000437

Gibson, Amy, Louisa Degenhardt, Richard P. Mattick, Robert Ali, Jason White, and Susannah O'Brien. 2008. "Exposure to Opioid Maintenance Treatment Reduces Long-term Mortality. *Addiction* 103(3): 462–468. https://doi.org/10.1111/j.1360-0443.2007.02090.x

Green, Traci C., Jennifer Clarke, Lauren Brinkley-Rubinstein, Brandon D. L. Marshall, Nicole Alexander-Scott, Rebecca Boss, and Josiah D. Rich. 2018. "Postincarceration Fatal Overdoses after Implementing Medications for Addiction Treatment in a Statewide Correctional System." *JAMA Psychiatry* 75(4): 405–407.

Grooms, Jevay, and Alberto Ortega. 2019. "Examining Medicaid Expansion and the Treatment of Substance Use Disorders." *AEA Papers and Proceedings* 109: 187–191. https://doi.org/10.1257/pandp.20191090

Gudin, Jeffrey A., Shanthi Mogali, Jermaine D. Jones, and Sandra D. Comer. 2013. "Risks, Management, and Monitoring of Combination Opioid, Benzodiazepines, and/or Alcohol Use." *Postgraduate Medicine* 125(4): 115–130. https://doi.org/10.3810/pgm.2013.07.2684

Ho, Chuong, and Charlene Argáez. 2018. "Telehealth-delivered Opioid Agonist Therapy for the Treatment of Adults with Opioid Use Disorder: Review of Clinical Effectiveness, Cost-effectiveness, and Guidelines." Canadian Agency for Drugs and Technologies in Health. https://www.ncbi.nlm.nih.gov/books/NBK537877/

Institute of Medicine. 1995. *Federal Regulation of Methadone Treatment*. Washington, DC: The National Academies Press. https://doi.org/10.17226/4899

Jaeger, Stephen, and Brian Fuehrlein. 2020. "Buprenorphine Initiation to Treat Opioid Use Disorder in Emergency Rooms." *Journal of the Neurological Sciences* 411. https://doi.org/10.1016/j.jns.2020.116716

Jarvis, Brantley P., August F. Holtyn, Shrinidhi Subramaniam, D. Andrew Tompkins, Emmanuel A. Oga, George E. Bigelow, and Kenneth Silverman. 2018. Extended-release Injectable Naltrexone for Opioid Use Disorder: A Systematic Review. *Addiction* 113(7): 1188–1209. https://doi.org/10.1111/add.14180

Johnson, Quentin, Brian Mund, and Paul J. Joudrey. 2018. "Improving Rural Access to Opioid Treatment Programs." *Journal of Law, Medicine & Ethics* 46(2): 437–439. https://doi.org/10.1177/1073110518782951

Jones, Christopher M., Melinda Campopiano, Grant Baldwin, and Elinore McCance-Katz. 2015. "National and State Treatment Need and Capacity for Opioid Agonist Medication-assisted Treatment." *American Journal of Public Health* 105(8): 55–63.

Kaiser Family Foundation. 2020. "Opioid Overdose Death Rates and All Drug Overdose Death Rates per 100,000 Population (Age-Adjusted)." Kaiser Family Foundation. February 13, 2020.

Kelty, Erin, and Gary Hulse. 2017. "Fatal and Non-fatal Opioid Overdose in Opioid Dependent Patients Treated with Methadone, Buprenorphine or Implant Naltrexone." *The International Journal on Drug Policy* 46: 54–60. https://doi.org/10.1016/j.drugpo.2017.05.039

Krantz, Mori J., and Philip S. Mehler. 2004. "Treating Opioid Dependence: Growing Implications for Primary Care." *Archives of Internal Medicine* 164(3): 277–288. https://doi.org/10.1001/archinte.164.3.277

Knudsen, Hannah K., Paul M. Roman, and Carrie B. Oser. 2011. "Facilitating Factors and Barriers to the Use of Medications in Publicly Funded Addiction Treatment Organizations," *Journal of Addiction Medicine* 4(2): 99–107. https://doi.org/10.1097/ADM.0b013e3181b41a32

Knudsen, Hannah K., and Jamie L. Studts. 2019. "Physicians as Mediators of Health Policy: Acceptance of Medicaid in the Context of Buprenorphine Treatment." *The Journal of Behavioral Health Services and Research* 46(1): 151–163. https://doi.org/10.1007/s11414-018-9629-4

Larochelle, Marc R., Jane M. Liebschutz, Fang Zhang, Dennis Ross-Degnan, and J. Frank Wharam. 2016. "Opioid Prescribing after Nonfatal Overdose and Association with Repeated Overdose." A*nnals of Internal Medicine* 164(1): 1–9. https://doi.org/10.7326/M15-0038

Larochelle, Marc R., Dana Bernson, Thomas Land, Thomas J. Stopka, Na Wang, Ziming Xuan, Sarah M. Bagley, Jane M. Liebschutz, and Alexander Y. Walley. 2018. "Medication for Opioid Use Disorder after Nonfatal Opioid Overdose and Association with Mortality." *Annals of Internal Medicine* 169(3): 137–145. https://doi.org/10.7326/M17-3107

Larochelle, Marc R., Ryan Bernstein, Dana Bernson, Thomas Land, Thomas J. Stopka, Adam J. Rose, Monica Bharel, Jane M. Liebschutz, and Alexander Y. Walley. 2019. "Touchpoints—Opportunities to Predict and Prevent Opioid Overdose: A Cohort Study." *Drug and Alcohol Dependence* 204(1): 107537. https://doi.org/10.1016/j.drugalcdep.2019.06.039

Lee J.D., E.V. Nunes, P Novo, et al. 2018. "Compar¬ative Effectiveness of Extended-release Naltrexone Versus Buprenorphine-naloxone for Opioid Relapse Rrevention (X:BOT): A Multicentre, Open-label, Randomised Controlled Trial." *Lancet* 391(10118): 309–318. https://doi.org/10.1016/S0140-6736(17)32812-X

Maclean, Johanna Catherine, and Brendan Saloner. 2017. "The Effect of Public Insurance Expansions on Substance Use Disorder Treatment: Evidence from the Affordable Care Act." NBER Working Paper 23342.

Manchester, Joyce, and Riley Sullivan. 2019. "Exploring Causes of and Responses to the Opioid Epidemic in New England." New England Public Policy Center Policy Reports 19-2. Federal Reserve Bank of Boston.

Mohlman, Mary Kate, Beth Tanzman, Karl Finison, Melanie Pinette, and Craig Jones. 2016. "Impact of Medication-assisted Treatment for Opioid Addiction on Medicaid Expenditures and Health Services Utilization in Vermont." *Journal of Substance Abuse* 67: 9–4. https://doi.org/10.1016/j.jsat.2016.05.002

National Academies of Sciences, Engineering, and Medicine. 2019. *Medications for Opioid Use Disorder Save Lives.* Washington, DC: The National Academies Press. https://doi.org/10.17226/25310

National Institute on Drug Abuse. 2020. "How Effective Are Medications to Treat Opioid Use Disorder?" National Institute on Drug Abuse Research Report. June 17, 202 National Institute on Drug Abuse. 2020. "How Effective Are Medications to Treat Opioid Use Disorder?" National Institute on Drug Abuse Research Report. June 17, 2020.

National Institute on Drug Abuse. 2018. "Principles of Drug Addiction Treatment: A Research-Based Guide (Third Edition)." National Institute on Drug Abuse, National Institutes of Health, Department of Health and Human Services.

Netherland, Julie, Michael Botsko, James E. Egan, Andrew J. Saxon, Chinazo O. Cunningham, Ruth Finkelstein, Mark N. Gourevitch, John A. Renner, Nancy Sohler, Lynn E. Sullivan, Linda Weiss, and David A. Fiellin. 2009. "Factors Affecting Willingness to Provide Buprenorphine Treatment." *Journal of Substance Abuse Treatment* 36(3): 244–251. https://doi.org/10.1016/j.jsat.2008.06.006

Pierce, Mathias, Sheila M. Bird, Matthew Hickman, John Marsden, Graham Dunn, Andrew Jones, and Tim Millar. 2015. "Impact of Treatment for Opioid Dependence on Fatal Drug-related Poisoning: A National Cohort Study in England." *Addiction* 111: 298–308. doi: 10.1111/add.13193

Pullen, Ellen, and Carrie Oser. 2014. "Barriers to Substance Abuse Treatment in Rural and Urban Communities: A Counselor Perspective," *Substance Use & Misuse* 49(7): 891–901. https://dx.doi.org/10.3109/10826084.2014.891615

Saloner, Brendan and Shankar Karthikeyan. 2015. "Changes in Substance Abuse Treatment Use among Individuals with Opioid Use Disorders in the United States, 2004–2013." *Journal of the American Medical Association* 314: 1515–1517. https://doi.org/10.1001/jama.2015.10345

Shapiro, Aaron, Lisa R. Villarroel, and Paul George. 2019. "A Call to Maximize Impact of the SUPPORT for Patients and Communities Act through Standard Inclusion of Opioid Use Disorder Treatment Curricula in Medical Schools." *Advances in Medical Education and Practice* 10: 581–583. doi: 10.2147/AMEP.S205946

Sordo, Luis, Gregorio Barrio, Maria J Bravo, B. Iciar Indave, Louisa Degenhardt, Lucas Wiessing, Marica Ferri, and Roberto Pastor-Bariusso. 2017. "Mortality Risk during and after Opioid Substitution Treatment: Systematic Review and Meta-analysis of Cohort Studies." *The BMJ* 2017; 357:j1550. doi: https://doi.org/10.1136/bmj.j1550

Stein, Bradley D., Mark Sorbero, Andrew W. Dick, Rosalie Liccardo Pacula, Rachel M. Burns, and Adam J. Gordon. 2016. "Physician Capacity to Treat Opioid Use Disorder with Buprenorphine-Assisted Treatment." *JAMA* 316(11): 1211–1212.

Thomas, Cindy Parks, Erin Doyle, Peter W. Kreiner, Christopher M. Jones, Joel Dubenitz, Alexis Horan, and Bradley D. Stein. 2017. "Prescribing Patterns of Buprenorphine Waivered Physicians." *Drug and Alcohol Dependenc*e 181: 213–218. https://doi.org/10.1016/j.drugalcdep.2017.10.002

Thornton, J. Douglas, Elizabth Lyvers, Virginia G. Scott, and Nilanjana Dwibedi. 2017. "Pharmacists' Readiness to Provide Naloxone in Community Pharmacies in West Virginia." *Journal of American Pharmacy Association* 57(2): 12–18. 10.1016/j.japh.2016.12.070

Volkow, Nora D., George F. Koob, and A. Thomas McLellan. 2016. "Neurobiologic Advances from Brain Disease Model of Addiction." *The New England Journal of Medicine* 374: 363–371.

Walley, Alexander Y., Debbie Cheng, C.E. Pierce, Clara Chen, T. Filippell, Jeffrey H. Samet, and D.P. Alford. 2012. "Methadone Dose, Take Home Status, and Hospital Admission among Methadone Maintenance Patients." *Journal of Addiction Medicine* 6: 186–190.

Wen, Hefei, Jason M. Hockenberry, and Harold A. Pollack. 2018. "Association of Buprenorphine-waivered Physician Supply with Buprenorphine Treatment Use and Prescription Opioid Use in Medicaid Enrollees." *JAMA Network Open* 1(5). https://doi.org/10.1001/jamanetworkopen.2018.2943

Williams, Arthur Robin, Hillary Samples, Stephen Crystal, and Mark Olfson. 2020. "Acute Care, Prescription Opioid Use, and Overdose following Discontinuation of Long-Term Buprenorphine Treatment for Opioid Use Disorder." *The American Journal of Psychiatry* 177(2): 117–124. doi: 10.1176/appi.ajp.2019.19060612

World Health Organization. 2009. "Guidelines for the Psychosocially Assisted Pharmacological Treatment of Opioid Dependence."

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Disclaimer

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