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The adoption of medications in substance abuse treatment: associations with organizational characteristics and technology clusters

Hannah K. Knudsen^{*}, Lori J. Ducharme, and Paul M. Roman

Address for all authors: Center for Research on Behavioral Health and Human Services Delivery, The University of Georgia, 101 Barrow Hall, Athens, GA 30602-2401

Abstract

Despite growing interest in closing the “research to practice gap,” there are few data on the availability of medications in American substance abuse treatment settings. Recent research suggests that organizational characteristics may be associated with medication availability. It is unclear if the availability of medications can be conceptualized in terms of “technology clusters,” where the availability of a medication is positively associated with the likelihood that other medications are also offered. Using data from 403 privately funded and 363 publicly funded specialty substance abuse treatment centers in the US, this research models the availability of agonist medications, naltrexone, disulfiram, and SSRIs. Bivariate logistic regression models indicated considerable variation in adoption across publicly funded non-profit, government-owned, privately funded non-profit, and for-profit treatment centers. Some of these differences were attenuated by organizational characteristics, such as accreditation, the presence of staff physicians, and the availability of detoxification services. There was some evidence that naltrexone, disulfiram, and SSRIs represent a group of less intensely regulated medications that is distinct from more intensely regulated medications. These types of medications were associated with somewhat different correlates. Future research should continue to investigate the similarities and differences in the predictors of medication availability across national contexts.

1. Introduction

The delivery of effective treatment services is a critical means for addressing the high social, medical, and economic costs of substance abuse (Mark et al., 2001; Rosenheck and Kosten, 2001). Although effective and promising substance abuse treatment medications have been developed and are available in the US (Anton, 2001), there is ample evidence that the rate of adoption of these medications by American treatment organizations has been slow (Lamb et al., 1998). Addressing this “research to practice gap” requires an understanding of the organizational characteristics that facilitate and deter the adoption of substance abuse treatment medications by providers (Fuller et al., 2005; Simpson, 2002).

Although psychosocial interventions are the predominant mode of substance abuse treatment delivered in the US (Mark et al., 2003b), much effort has been directed toward the development of effective pharmacotherapies (McLellan and McKay, 1998). Agonist medications, such as

^{*}Corresponding author. Tel.: +1 706 542-6090. Email address: hknudsen@uga.edu (H.K. Knudsen)..

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methadone and buprenorphine, are a key group of pharmacotherapies for individuals who are dependent on opiates. This class of medications is highly regulated in the US, with clinics and prescribing physicians facing specific regulatory requirements (Jaffe and O'Keefe, 2003). A large literature has established methadone maintenance (MMT) as an evidence-based treatment for opiate dependence (Hubbard et al., 1997; Mattick et al., 2003; Ward et al., 1999; NIH, 1997). MMT has tended to be concentrated within a treatment sector consisting of opioid treatment programs (OTPs) that exclusively dispense this medication. At the same time, about half of the providers of MMT in the US operate within mixed-modality settings (SAMHSA, 2002), which may or may not utilize other pharmacotherapies for their non-opiate dependent clients.

In 2002, the US Food and Drug Administration (FDA) approved buprenorphine, a partial agonist medication, for both opiate detoxification and maintenance. Buprenorphine reduces withdrawal symptoms and blocks the effects of opiates (Walsh and Eissenberg, 2003). Numerous clinical trials have evaluated the effectiveness of buprenorphine in comparison to placebo (Fudula et al., 2003), clonidine (Ling et al., 2005; Gowling et al., 2004; Lintzeris et al., 2002), and methadone (Johnson et al., 1992; Johnson et al., 2000; Pani et al., 2000; Schottenfeld et al., 1997; Strain et al., 1994). Although buprenorphine may not be more effective than methadone, it has three key advantages: it does not require daily dosing (Amass et al., 2001), its chemical composition reduces the likelihood of diversion (Amass et al., 2000), and federal regulations encouraging its prescription by primary care physicians may facilitate its integration into community-based treatment programs (Amass et al., 2004). However, there are still certain regulatory requirements that must be met in order for physicians to prescribe this medication (Koch et al., 2006).

Other medications, such as naltrexone and disulfiram, address a wider range of substances, including alcohol, cocaine, and opiate dependence. Relative to agonist medications, they are less highly regulated in the US in that any physician can prescribe them. Naltrexone, an antagonist medication, may have utility in preventing relapse among opiate dependent clients who are motivated to achieve abstinence (Brahen et al., 1978; O'Brien et al., 1984; Greenstein et al., 1981). For alcohol-dependent clients, compliance with naltrexone results in a range of improved outcomes, such as reduced likelihood of relapse and lower consumption of alcohol. However, a major problem with this medication is sustaining patient compliance (Kranzler and Van Kirk, 2001; Streeton and Whelan, 2001; O'Malley et al., 1992; Volpicelli et al., 1992).

Disulfiram may be useful in enhancing retention during treatment (Chandrasekaran et al., 2001) and in relapse prevention (Hunt, 2002). In recent studies it has shown promise in treating individuals with co-occurring cocaine and alcohol dependence (Carroll et al., 2000; Carroll et al., 1998; Kosten et al., 2002). As with naltrexone, the effectiveness of disulfiram is contingent on patients' compliance with the prescribed dose and schedule (Brewer et al., 2000; Kranzler, 2000; Litten and Allen, 1999).

To date, there are few data that examine rates of organizational adoption of these medications in the American specialty substance abuse treatment systems, and even less attention has been paid to the organizational correlates associated with medication adoption. The emergent literature on medication adoption has been limited to regional samples (Fuller et al., 2005), private sector facilities (Knudsen et al., 2005; Roman and Johnson, 2002), and the practices of individual physicians (Mark et al., 2003a; Mark et al., 2003b). Understanding the role of treatment organizations is critical because recent research has revealed that the organizational context dramatically affects the prescribing behaviors of physicians and the likelihood that counselors will encourage and/or support the use of medications by their clients (Thomas et al., 2003).

Certain organizational characteristics may be associated with the likelihood that medications are offered by the center as part of its treatment protocol. For example, the American substance abuse treatment system is comprised of a range of treatment centers, including government-owned facilities, non-profit organizations highly dependent on public funds, centers that are non-profit but reliant on private sources of funding, and for-profit organizations (White, 1998). These different types of organizations are subject to different environmental contingencies (Perry and Rainey, 1988; Walmsley and Zald, 1973), which may result in differences in patterns of service delivery. Furthermore, there has been a longstanding concern that disparities in access to high-quality services may exist for clients served by the public treatment system (Rodgers and Barnett, 2000; Yahr, 1986).

Accreditation status may also be associated with medication adoption. Some have argued that accreditation is a proxy measure of program quality (Alexander and Wheeler, 1998), because accrediting organizations require centers to meet a variety of quality indicators. Thus, the adoption of pharmacotherapies may be greater among accredited treatment programs.

Medication availability may also be related to the levels of care offered by treatment centers. For example, centers with detoxification services may have greater medical resources given the more urgent medical needs of their clients; those medical resources may also prove useful for the delivery of treatment medications. In addition, centers with inpatient programming may be better equipped to provide the medical monitoring that can increase medication compliance (Knudsen et al., 2005). Thus, levels of care may be proxy variables for differential availability of medical resources. It is less clear if levels of care are associated with the availability of pharmacotherapies when other measures of medical resources are taken into account.

Staffing may also be an important issue related to the adoption of treatment innovations (Saxon and McCarty 2005). Access to physicians is critical for medication adoption. Such access is neither universal nor uniform in American substance abuse treatment settings. In addition, previous research suggests that workforce professionalism (Damanpour, 1991), such as greater employment of Master's-level counseling staff, may be associated with greater innovation adoption (Knudsen et al., 2005; Knudsen and Roman, 2004; Roman and Johnson, 2002).

To date, most organizational analyses have tended to focus on the adoption of a specific pharmacotherapy, making it difficult to discern whether these correlates generalize across a range of medications. In particular, it is unknown if the same set of organizational characteristics are associated with the adoption of more intensely regulated medications (e.g. methadone, buprenorphine) as well as the availability of less intensely regulated medications (e.g. naltrexone, disulfiram).

Previous research that has considered the adoption of individual medications have rarely considered if and how the availability of one medication may be associated with the likelihood that other medications are also offered by the center. Rogers (1995), in his classic work, *Diffusion of Innovations*, argued that innovations sharing certain characteristics may represent "technology clusters." Specifically, the adoption of one medication suggests that the organization has overcome key resource-related and philosophical barriers to medication use such that additional medications may be adopted with less difficulty. This notion is consistent with Rogers' theory regarding organizational compatibility in which he argues that new innovations are more likely to be adopted if they are consistent with previously introduced ideas. Thus, the availability of one medication may increase the likelihood that other medications are also used; this hypothesis has rarely been tested in the context of substance abuse treatment organizations. There are two notable exceptions. Koch et al.'s (2006) cross-sectional analysis of buprenorphine adoption found a positive correlation between the availability of this medication and naltrexone. Fuller et al.'s longitudinal research (2005)

indicated that the adoption of selective serotonin reuptake inhibitors (SSRIs), commonly used to treat mood disorders, may serve as a “gateway” to the adoption of naltrexone over time.

To summarize, relatively little is known about the extent to which public and private substance abuse treatment centers in the US have adopted treatment medications, such as agonist therapies, naltrexone, and disulfiram. Furthermore, it is unclear whether certain characteristics of these organizations are associated with medication adoption, and if there are patterns of association between medications. This research addresses these issues using large, nationally representative samples of American specialty substance abuse treatment facilities in the private and public sectors.

2. Methods

2.1. Sampling

Data for these analyses are drawn from the National Treatment Center Study (NTCS), a family of National Institute on Drug Abuse-funded research projects that measures changes within the American specialty substance abuse treatment system using a panel longitudinal design. The present study uses cross-sectional data collected from nationally representative samples of 403 privately funded and 363 publicly funded substance abuse treatment centers. Face-to-face interviews were conducted with center administrators and/or clinical directors in 2002–2004. Similar sampling and data collection procedures were employed in both studies.

Beginning in 1995, the NTCS initially focused on service delivery changes occurring within the private substance abuse treatment system (Johnson and Roman, 2002; Milne et al., 2000). Using a two-stage sampling design, an initial panel of 450 treatment facilities was selected. The first stage of sampling involved the random selection of counties based on population. This procedure resulted in counties being selected from 35 states. Within the sampled counties, all substance abuse treatment facilities were enumerated using published directories, federal and state provider listings, and other resources such as EAP directories and the yellow pages. From these lists, treatment centers were randomly selected proportionate to the total number of centers in the sampled counties. This use of multiple sources to compile the sampling frame ensured broad representation of private sector facilities, many of which do not appear in federal or state listings. In fact, 26% of all private centers in this sample are not listed on the SAMHSA’s *National Facilities Register*, from which national samples of treatment organizations are usually drawn.

Sampled private centers were contacted by telephone for a brief screening interview to establish eligibility for the study. Ineligible centers and refusals were replaced with centers randomly selected from the same geographic stratum. Three key criteria determined eligibility. First, centers were required to be located in the community, meaning that services were available to the general public; this requirement excluded Veteran’s Administration (VA) and correctional facilities. Second, the organization had to provide a level of substance abuse treatment at least equivalent to structured outpatient as defined by the American Society of Addiction Medicine (Mee-Lee et al., 1996). This requirement excluded settings such as facilities that only offer detoxification services, halfway houses, counselors in private practice, and programs exclusively offering methadone maintenance services. Treatment centers offering methadone maintenance along with other modalities were eligible for inclusion. Finally, in order to be considered a “private center,” treatment organizations were required to receive less than 50% of their annual operating revenues from government block grants and other federal, state or local grants or contracts. On average, centers received less than 20% of their operating revenues from these sources.

Four waves of face-to-face interviews have been completed with private treatment facilities in this study sample. At each wave, the sample has been refreshed with randomly selected centers in order to replace centers that have closed or refused to participate in subsequent interviews. The following analyses use data from the most recent set of 403 interviews, collected over an 18 month period from mid 2002 to early 2004. During this wave of data collection, a participation rate of 88% was achieved among private centers that remained open and eligible.

In 2002, a companion sample of 363 publicly funded substance abuse treatment centers was added to the NTCS so that comparisons could be made between the public and private sectors. The overall design of the public center study was similar to that of the private center study. Again, a two-stage sampling strategy was utilized, and facilities were required to be community-based and offer a minimum of structured outpatient treatment. The critical difference is that treatment centers in the public center sample were required to receive at least 50% of their annual operating revenues from government block grants and/or government contracts. The public center sample includes both government-owned facilities and privately-owned nonprofit centers that are heavily dependent on government funding sources. The average center in this sample received more than 84% of its annual operating revenues from such public sources. A participation rate of 80% was achieved among eligible publicly funded centers, with interviews conducted between mid 2002 and early 2004.

2.2. Measures

This analysis considers the availability of four types of medications. First, centers are categorized according to whether they had adopted any of three agonist medications: buprenorphine, methadone, and/or levo-alpha-acetyl-methadol (LAAM). Although the manufacturing of LAAM was discontinued in early 2005, it was available throughout the data collection period for this study and was included in the data instrument. For each of these medications, administrators were first asked if any clients had ever been treated with each medication at the center. Affirmative responses were then followed by an additional question that asked administrators if the medication was currently used to treat clients. A dichotomous measure of agonist availability was generated such that centers reporting current use of buprenorphine, methadone, and/or LAAM were coded 1, while 0 indicated the center did not currently use any of the three medications.

Three other types of medication availability were measured. Specifically, administrators were asked if their center had ever treated any clients using naltrexone, disulfiram, and/or SSRIs. As with the measure for agonist medications, affirmative responses were then followed by questions about whether each medication was currently used to treat clients. These data were coded into three dichotomous measures of medication availability (1 = medication is currently used, 0 = medication is not currently used).

The independent variables included measures of center type, organizational affiliation, basic organizational characteristics, treatment philosophy, levels of care, staffing, and caseload characteristics. *Center type* was classified into four groups: government-owned, publicly funded non-profit (reference category), privately funded non-profit, and for-profit. Publicly funded nonprofits were defined as receiving more than 50% of their revenues from governmental block grants and contracts, while privately funded non-profit centers received less than 50% of their funding from these sources. Organizational affiliation was measured as a set of dummy variables including hospital-affiliated, mental health center affiliated, and freestanding. Mental health center affiliation was established using the Substance Abuse and Mental Health Services Administration (SAMHSA) Mental Health Services Locator (<http://www.mentalhealth.samhsa.gov/databases/>), which identifies providers that are primarily mental health organizations. Other basic organizational characteristics included *center age* in years, *center size* based on the number of full-time equivalent employees (natural

log-transformed to adjust for skew), and *accreditation* by either JCAHO or CARF (1 = accredited, 0 = non-accredited). The measure of treatment philosophy indicated whether the center was based on a *12-step model of recovery* (1 = 12-step model, 0 = other treatment model).

The measures of levels of care focused on both detoxification and treatment services. Administrators indicated if their facility offered *inpatient detoxification* (1 = yes, 0 = no) and/or *outpatient detoxification* (1 = yes, 0 = no). In addition, centers were categorized as offering any *inpatient treatment* services for adults and/or adolescents (1 = yes, 0 = no) or *residential care* (1 = yes, 0 = no). The final level of care variable was the availability of *outpatient programming* (1 = yes, 0 = no).

Staffing is measured in terms of physician resources and counselor characteristics. *Access to physicians* used three categories, dividing centers into those that employed any staff physicians, those that retained any physicians via contractual relationships, and those without formal relationships with physicians (reference category). The two counselor characteristics included in these analyses were the *percentage of counselors with a Master's-level degree or higher* and the *percentage of counselors that were certified in addiction treatment*.

Finally, two measures of caseload characteristics are included in the analyses. Administrators reported the percentage of clients with a *primary diagnosis of alcohol abuse/dependence*. They also indicated the percentage of clients with a *primary diagnosis of opiate abuse/dependence*.

2.3. Analysis

Descriptive statistics and logistic regression analyses were conducted using Stata 9.2 (StataCorp, College Station, TX), while the multivariate structural equation model of medication adoption was estimated using the Mplus 3.12 statistical software package (Muthen & Muthen, Los Angeles, CA). Prior to estimating the multivariate logistic regression models, the procedures described by Allison (1999) were employed to assess whether multicollinearity was a significant problem in the analyses. There was no evidence that multicollinearity was unduly influencing the findings. Listwise deletion was utilized in all analyses; complete data were available from 665 centers. Comparisons of centers with complete data to those that were excluded due to missing data revealed no significant differences on any of the variables (not shown).

3. Results

3.1. Descriptive Statistics

The rates of medication adoption were 18.1% for agonist medications, 21.2% for naltrexone, 24.2% for disulfiram, and 49.3% for SSRIs. About 12.9% of the sampled programs were government-owned facilities, while 15.2% operated on a for-profit basis. Publicly funded centers comprised 34.6% of sampled centers, and about 37.3% of centers were privately funded non-profit organizations. Descriptive statistics for the remaining variables appear in Table 1. Oneway analysis of variance (ANOVA) procedures were used to detect significant differences across the four types of centers. Notably, the F-statistics were significant for all four medications, indicating significant variation in availability of medications by center type.

A series of bivariate logistic regression models were estimated in order to examine the associations between the availability of the four medications and organizational characteristics. The unadjusted odds ratios from these analyses appear in Table 2. Most of the organizational characteristics were associated with the availability of the four medications at the bivariate level. Although the overall rates of medication adoption were low (Table 1), these analyses suggested that the likelihood of medication availability was substantially greater in specific

settings. There were substantial differences in the likelihood that these medications were available based on center type, particularly between publicly funded non-profit organizations and the two types of privately funded centers. In addition, the rate of medication availability in hospital-based centers was between 3.5 and 5.0 times greater than the rates in freestanding clinics. Medication availability was consistently greater in centers offering detoxification services and inpatient treatment. As expected, centers reporting the presence of at least one staff physician were more likely to offer the four medications.

In addition, there was a notable pattern in which each medication was positively associated with the likelihood that the other medications were offered by the center. Centers offering SSRIs were five to eight times more likely to have adopted the addiction-specific medications than centers that did not use SSRIs to treat clients. In addition, there was a strong bivariate association between the availability of disulfiram and naltrexone.

3.2. Logistic Regression Models of Specific Medications

Table 3 presents the results of four multivariate logistic regression analyses in which the availability of each medication is regressed on organizational characteristics. The results for the model of agonist medication availability appear in the first column. Neither center type nor organizational affiliation was associated with agonist medication availability once other organizational characteristics were controlled. There was a strong association between center accreditation and the likelihood of agonist medication adoption, such that accredited centers were nearly four times more likely to offer agonist medications ($e^b = 3.949$). In addition, there was a positive association between center size and the availability of agonists ($e^b = 1.376$), such that larger centers were more likely to have adopted these more intensely regulated medications.

Two levels of care were associated with agonist medication availability. These medications were more likely to be offered in centers with outpatient detoxification programs than in centers not offering this service ($e^b = 2.675$). Centers offering a residential level of care were about 54.4% less likely to have adopted agonists than centers without residential programs ($e^b = .456$).

Of the staffing variables, only the measure of physician resources was significantly associated with the availability of agonist medications. Centers with a staff physician were about 3.4 times more likely to have adopted agonist medications than centers without physicians ($e^b = 3.397$). Finally, there was a positive association between the adoption of agonist medications and the percentage of opiate-dependent clients treated by the center. A standard deviation increase in the percentage of primary opiate dependent clients ($SD = 18.75$) approximately doubled the likelihood that the center offered these medications ($e^{b(SDx)} = 2.014$).

The logistic regression model of naltrexone availability on organizational characteristics appears in the second column of Table 3. In contrast to the model of agonist medications, there was some evidence that center type and organizational affiliation was associated with the likelihood of naltrexone availability. For-profit centers were about three times more likely than publicly funded non-profit centers to offer naltrexone, net of other organizational characteristics ($e^b = 3.213$). Additionally, the difference between privately funded non-profit and their publicly funded non-profit counterparts neared significance ($e^b = 1.993$, $p = .051$). Of the organizational affiliation measures, the difference between hospital-based centers and freestanding clinics was significant ($e^b = 1.893$). Center accreditation was not associated with the availability of naltrexone, once other organizational characteristics were controlled.

In terms of levels of care, only the measures of detoxification services were significantly associated with the likelihood of naltrexone availability. Centers offering inpatient

detoxification ($e^b = 3.172$) and facilities offering outpatient detoxification ($e^b = 2.458$) were more likely to treat clients using naltrexone than centers that did not offer these services.

As with the model of agonist medications, only the measure of having a physician on staff was significantly associated with the likelihood of naltrexone availability ($e^b = 1.993$) once other organizational characteristics were controlled. Having access to a contract physician appeared to increase the likelihood of naltrexone availability, but this association only approached significance ($e^b = 1.822$, $p = .088$). The positive association between Master's-level counselors and naltrexone availability also approached significance ($e^b = 1.007$, $p = .055$).

The third column of Table 3 presents the logistic regression model of disulfiram availability on organizational characteristics. This model shared some similarities with the model of naltrexone, although there were also some differences. As with naltrexone, for-profit centers were more likely to have adopted disulfiram than publicly funded non-profit centers ($e^b = 2.146$). However, government-owned centers were also more likely to offer this medication than their publicly funded non-profit counterparts ($e^b = 2.310$). Consistent with the model of naltrexone availability, hospital-based programs were more likely to have adopted disulfiram than freestanding facilities ($e^b = 2.621$).

Disulfiram was the only medication for which the measure of treatment philosophy was significantly associated with the availability of a medication. Twelve-step centers were about 37.9% less likely to offer disulfiram than centers based on other treatment models ($e^b = .621$).

The associations between staffing and disulfiram availability were quite similar to the model of naltrexone. Only the measure of staff physicians was significantly associated with the likelihood of disulfiram availability ($e^b = 1.823$). The difference between centers with contract physicians and centers without a formal relationship with a physician approached significance ($e^b = 1.745$, $p = .064$). The positive association between Master's-level counselors and disulfiram availability also approached significance ($e^b = 1.006$, $p = .059$). There was a trend for the percentage of certified counselors being positively associated with the odds that this medication was offered ($e^b = 1.006$, $p = .075$); this finding was unique to disulfiram.

Finally, the logistic regression model of SSRI availability on organizational characteristics appears in the fourth column of Table 3. Although there was a trend for government-owned ($e^b = 1.690$, $p = .079$) and privately funded non-profit centers ($e^b = 1.579$, $p = .088$) being more likely to offer SSRIs than publicly funded non-profit centers, neither association achieved statistical significance. However, both measures of organizational characteristics were significant. Relative to freestanding facilities, programs based in hospitals ($e^b = 1.800$) or in mental health centers ($e^b = 2.580$) were significantly more likely to offer SSRIs.

The only level of care associated with SSRI availability was inpatient detoxification. The likelihood that the center offered SSRIs was significantly greater in centers with inpatient detoxification programs ($e^b = 1.906$), relative to centers without this service.

In terms of staffing, the presence of staff physicians ($e^b = 3.030$) and contract physicians ($e^b = 2.118$) were positively associated with the likelihood of SSRI availability. In addition, there was a significant positive association between the percentage of Master's-level counselors and SSRI availability. A standard deviation increase in Master's-level counselors ($SD = 33.97$) was associated with an 82.0% increase in the odds of SSRI availability ($e^{b(SDx)} = 1.820$).

3.3. Multivariate Model of Availability of Less-Intensely Regulated Medications and Agonist Medications

Given the associations between medications identified in Table 2, additional analyses considered whether these medications could be combined in a structural equation model of medication availability. Preliminary analyses indicated that a model in which the four medications were combined into a single latent variable did not fit the model well, as seen its weighted root mean square residual (WRMR) of 1.072. Yu and Muthen (2002) argue that the WRMR should be below .90 for latent variables using categorical indicators. The multivariate model presented in Table 3 examines the associations between the organizational characteristics and two dependent variables: a latent variable consisting of the measures of naltrexone, disulfiram, and SSRI availability and an observed dependent variable of agonist medication availability. The factor loadings for naltrexone, disulfiram, and SSRIs were .775, .821, and .841, respectively. There was a significant positive correlation between the latent measure of less-intensely regulated medications and the measure of agonist medication adoption. This model fit the data better than the preliminary model (WRMR = .743).

In the first column of Table 3, the associations between the availability of the less intensely regulated (LIR) medications and organizational characteristics are estimated. There were significant differences in LIR medication availability based on center type. Relative to publicly funded non-profit centers, government-owned and for-profit centers were more likely to currently use these LIR medications. There was trend for greater adoption in privately funded non-profit centers ($p < .06$) but it did not achieve statistical significance. Organizational affiliation was also significantly associated with the availability of these less-regulated medications. Compared to freestanding facilities, hospital-based programs and mental health centers were significantly more likely to offer LIR medications.

Of the measures of levels of care, detoxification services were positively associated with the availability of LIR medications. Centers providing inpatient detoxification and organizations offering outpatient detoxification were significantly more likely to treat clients with medications than programs without these services. Medication availability was not associated with the three treatment-related levels of care.

There was some evidence that staffing was associated with LIR medication availability. As expected, centers with at least one physician on staff and centers with a contractual relationship with a physician were more likely than centers without formal relationships with physicians to have adopted these LIR medications. Additionally, there was a significant positive association between the percentage of Master's-level counselors and the availability of LIR medications ($\beta = .207$).

The correlates of agonist medication availability are presented in the second column of Table 4. There were not substantive differences in terms of statistical significance between the previous logistic regression model of agonist availability (Table 3) and this analysis, which takes into account the correlation between agonist and LIR medications.

4. Discussion

These data from nationally representative samples of American substance abuse treatment centers in the public and private sectors revealed a modest degree of medication adoption. Centers were considerably more likely to report having adopted SSRI medications than pharmacotherapies specifically approved for the treatment of substance abuse. Almost half of centers currently use SSRIs to treat patients, and centers offering this type of medication were more likely to report to have adopted the other medications. It may be the case that SSRI adoption represents a gateway for greater medication adoption in American treatment centers.

Support for this argument was recently demonstrated by Fuller et al.'s (2006) longitudinal analysis of naltrexone adoption, where the adoption of SSRIs was positively associated with subsequent addition of naltrexone to the center's treatment programming.

These data suggest that the availability of a given medication is more likely when other medications are available, a finding consistent with Koch et al.'s (2006) recent work. The correlations between treatment medications suggest that there may be value in considering patterns of availability between medications. However, there was also evidence that the organizational correlates of medication availability is, in part, shaped by the type of medication; this finding is consistent with Rogers (1995) who argued that innovation adoption is shaped by the fit between an innovation's characteristics and the organizational context. In the case of substance abuse treatment pharmacotherapies, there was some indication that medications may be differentiated by the extent to which they are regulated. In the US, there are additional requirements that must be met in order for treatment centers to offer agonist medications in contrast to other pharmacotherapies which any physician may prescribe. The logistic regression models of medication availability suggested similarities in organizational correlates between the three less-intensely regulated medications; a model treating these medications as a single latent variable fit the data well. For agonist medications, there were certain organizational correlates that were unique to this class of medications, suggesting the need to consider these medications as distinct from the less-intensely regulated pharmacotherapies.

The relevance of the regulatory environment comes into sharper focus in the final model that simultaneously estimated the correlates of the less-intensely regulated (LIR) medications and agonist medications. In the US, the regulation of agonist medications has shifted to an accreditation-based system. Consistent with this aspect of the regulatory environment, accredited centers were significantly more likely to offer these medications when other organizational characteristics were controlled. Although center type and organizational affiliation were associated with agonist medication availability at the bivariate level, these measures were no longer significant once accreditation and other organizational characteristics were taken into account. In contrast, accreditation was associated with the three LIR medications at the bivariate level, but was no longer significantly associated with the LIR medications once other organizational variables were controlled. Center type, which integrated data on ownership, profit status, and predominant source of funding, was associated with the LIR medications, as was the measure of organizational affiliation. This suggests that accreditation is less relevant to the adoption of LIR medications because these medications are not subject to the same regulations.

The finding that center type is associated with LIR medication availability in American treatment centers suggests that there are disparities in the quality of care received by clients based on the types of organizations from which they seek care. In particular, non-profit centers highly reliant on public funding appear to lag behind other types of treatment facilities in terms of offering these medications, even after controlling for other organizational characteristics such as medical resources. However, it is precisely this dependence on governmental funding that may serve as a lever through which policy changes can facilitate medication adoption. These organizations are accountable to state governments for the services they deliver in a way that privately funded programs are not; if funding is linked to the delivery of evidence-based substance abuse treatment services, such as medications, this difference in medication availability may begin to narrow (Capoccia, 2006).

These results begin to suggest the types of American treatment organizations where medications are more likely to be used. Medical resources, as would be expected, appear to be a critical issue. Centers offering detoxification services, indicative of a greater ability to medically manage addiction, were more likely to offer medications. However, these services

are not highly prevalent in American specialty substance abuse centers, particularly in the public sector. In addition, the presence of at least one staff physician was associated with both types of medications. Publicly funded non-profit organizations were the least likely to have this type of physician access. It appears that there are also substantial structural barriers to the adoption of medications in this segment of the American treatment system. Given that publicly funded nonprofits represent the largest segment of the overall treatment system (Horgan and Levine, 1998), these structural differences are particularly significant to the overall process of moving evidence-based medications into routine practice.

Interestingly, there were mixed results for the measure of treatment philosophy. At the bivariate level, 12-step programs were more likely to offer naltrexone, but this association was no longer significant once other organizational factors were controlled. In the multivariate model of disulfiram availability, 12-step centers were less likely to offer this medication; there was a similar trend for SSRI availability. However, in the structural equation model where LIR medications were treated as a single latent variable, this measure of treatment philosophy was not significantly associated with either LIR or agonist medication availability. It appears that structural features of organizations, such as accreditation, center type, and physician resources, may be more relevant than treatment philosophy in terms of medication availability.

There are several limitations in these analyses due to the research design. First, the data are cross-sectional, which limits the ability to test causal relationships. The analyses address a limited number of treatment medications, so it is unclear whether these findings would generalize to other medications, such as acamprosate, which recently received FDA-approval in the US, or sedative hypnotics. Additionally, these analyses were only concerned with adoption of medications, and therefore, cannot speak to the issue of implementation. Consideration of how routinely these medications are prescribed and the proportion of eligible clients receiving them are important directions for future research.

In addition to limitations related to measurement, there are other limitations related to the types of organizations studied. While the samples are representative of the majority of specialty substance abuse treatment facilities operating in the US, it is unknown whether and to what extent these findings may generalize to VA settings, correctional facilities, opioid treatment programs, and clinicians in private practice, who were excluded from the research design.

It is also unclear the extent to which these findings would generalize to other national contexts. Some findings, such as the association between access to physicians and medication availability, would probably remain relevant in other countries. However, other findings are perhaps context-specific due to the influence of US policies. For example, the association between accreditation and availability of agonist medications may reflect the policy changes that have shifted the regulation of MMT to an accreditation-based system (CSAT, 1999; Jaffe and O'Keefe, 2003). Relatedly, the organizational affiliations of treatment providers (e.g. hospitals, community mental health centers, and freestanding clinics) and the types of centers (based on funding and ownership) also reflect the evolution of a treatment system within a particular social context (White, 1998). Finally, the medications available for adoption are dramatically shaped by national policies. For example, emergent treatment medications, such as buprenorphine and acamprosate, were available in European markets before they received approval in the US (Bridge et al., 2003; Kranzler, 2000). Future research should begin to document the range of treatment services available across national contexts. Such data would allow researchers to identify factors that influence innovation adoption across contexts and those factors that are nation-specific.

In summary, these data from the NTCS suggest that there are substantial differences in medication adoption between the public and private sectors within the American treatment

system. These differences are partly a function of differences in organizational characteristics. These data also suggest that the presence of staff physicians is a key resource for medication adoption, and that contractual relationships with physicians may not be sufficient for the expansion of pharmacotherapy use in the specialty treatment system in the US. While centers offering detoxification services were significantly more likely to use these medications, their technology is predisposed to embrace the adoption of pharmacotherapies, and, moreover, such centers represent a minority in the treatment system. These results also suggest that future research should continue to explore which types of predictors are consistently associated with medication adoption in general and which are only associated with specific types of medication. Finally, the patterns of relationships between medications should be considered in future research on innovation adoption in substance abuse treatment settings.

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Table 1

Descriptive Statistics of Medication Availability and Organizational Characteristics for All Centers and by Center Type (n = 665)

	Total Sample % (N) or Mean(SD)	Government Owned% (N) or Mean (SD)	Public Non- Profit% (N) or Mean (SD)	Private Non- Profit% (N) or Mean (SD)	For-Profit% (N) or Mean (SD)
Availability of Agonist Medications ***	18.05% (120)	13.95% (12)	8.26% (19)	26.61% (66)	22.77% (23)
Availability of Naltrexone ***	21.20% (141)	11.63% (10)	7.39% (17)	32.66% (81)	32.67% (33)
Availability of Disulfiram ***	24.21% (161)	29.07% (25)	11.74% (27)	31.45% (78)	30.69% (31)
Availability of SSRIs ***	49.32% (328)	51.16% (44)	31.30% (72)	64.92% (161)	50.50% (51)
Organizational Affiliation ***					
Hospital	29.47% (196)	15.12% (13)	2.61% (6)	59.68% (148)	28.71% (29)
Mental Health Center	7.52% (50)	16.28% (14)	9.13% (21)	5.24% (13)	1.98% (2)
Freestanding	63.01% (419)	68.60% (59)	88.26% (203)	35.08% (87)	69.31% (70)
Center Age in Years **	23.71 (17.15)	21.56 (10.18)	23.66 (14.54)	26.39 (21.10)	19.04 (15.39)
Center Size in LN(FTEs) ***	2.85 (1.13)	3.01 (1.02)	2.80 (.99)	2.91 (1.17)	2.66 (1.37)
Accredited Center ***	48.12% (320)	29.07% (25)	29.96% (62)	72.58% (180)	52.48% (53)
12-Step Model ***	67.82% (451)	55.81% (48)	60.87% (140)	73.79% (183)	79.21% (80)
Offers Inpatient Detoxification ***	29.02% (193)	19.77% (17)	10.87% (25)	44.76% (111)	39.60% (40)
Offers Outpatient Detoxification *	10.83% (72)	6.98% (6)	8.26% (19)	15.32% (38)	8.91 (9)
Offers Inpatient Treatment ***	33.53% (223)	29.07% (25)	14.78% (34)	47.18% (117)	46.53% (47)
Offers Residential Care ***	30.23% (201)	29.07% (25)	44.35% (102)	20.56% (51)	22.77% (23)
Offers Outpatient Care ***	83.01% (552)	77.91% (67)	76.52% (176)	87.90% (218)	90.10% (91)
Access to Physicians					
Physician(s) on Staff	41.20% (274)	44.19% (38)	25.65% (59)	51.21% (127)	49.50% (50)
Physician(s) on Contract	30.53% (203)	30.23% (26)	37.39% (86)	27.82% (69)	21.78% (22)
No Physician(s)	28.27% (188)	25.58% (22)	36.96% (85)	20.97% (52)	28.71% (29)
% Master's-Level Counselors ***	44.51 (33.97)	39.06 (30.80)	35.03 (33.01)	53.89 (32.42)	47.73 (36.15)
% Certified Counselors	58.25 (34.57)	59.00 (30.88)	55.47 (36.02)	60.03 (33.59)	59.56 (36.58)
% Primary Alcohol Clients ***	45.14 (23.99)	40.20 (24.07)	39.12 (23.83)	49.96 (22.00)	51.22 (25.14)
% Primary Opiate Clients	16.42 (18.75)	14.51 (17.67)	14.33 (18.36)	18.65 (19.58)	17.31 (18.00)
N	665	86	230	248	101

Significant differences by center type (ANOVA or chi-square depending on level of measurement),

*
p<.05,

**
p<.01,

p<.001

Table 2
Bivariate Logistic Regression Analyses of Medication Availability on Organizational Characteristics (n = 665)

	Availability of Agonists Unadjusted Odds Ratio	Availability of Naltrexone Unadjusted Odds Ratio	Availability of Disulfiram Unadjusted Odds Ratio	Availability of SSRIs Unadjusted Odds Ratio
Center Type				
Government-Owned	1.801	1.649	3.081 ***	2.299 **
Public Non-Profit	Reference	Reference	Reference	Reference
Private Non-Profit	4.027 ***	6.077 ***	3.450 ***	4.061 ***
For Profit	3.275 ***	6.080 ***	3.330 ***	2.238 **
Organizational Affiliation				
Hospital	3.924 ***	5.082 ***	3.560 ***	4.643 ***
Mental Health Center	1.054	1.584	1.814	2.808 **
Freestanding	Reference	Reference	Reference	Reference
Center Age in Years	1.003	1.006	1.000	1.002
Center Size in LN(FTEs)	1.845 ***	1.337 **	1.153	1.563 ***
Accredited Center	7.913 ***	4.387 ***	2.116 ***	3.875 ***
12-Step Model	.938	1.813	.826	.935
Offers IP Detoxification	4.204 ***	5.847 ***	2.561 ***	4.281 ***
Offers OP Detoxification	4.591 ***	3.102 ***	3.506 ***	2.986 ***
Offers Inpatient Treatment	4.275 ***	3.115 ***	1.827 **	3.438 ***
Offers Residential Care	.520 **	.679	.492 **	.792
Offers Outpatient Care	1.108	3.205 **	2.567 **	1.278
Physician Resources				
Physician(s) on Staff	12.648 ***	4.175 ***	3.048 ***	6.671 ***
Physician(s) on Contract	3.304 **	2.246 **	1.775 *	2.486 ***
No Physician(s)	Reference	Reference	Reference	Reference
% Master's Counselors	1.003	1.012	1.010	1.019
% Certified Counselors	.994	.997	1.003	.993
% Primary Alcohol Clients	.990 *	1.011	1.008 *	1.002
% Primary Opiate Clients	1.050 ***	1.008	1.012 **	1.018 ***
Agonists Are Available	N/A	3.089 ***	3.504 ***	5.088 ***
Naltrexone Is Available	3.089 ***	N/A	8.555 ***	8.681 ***
Disulfiram Is Available	3.504 ***	8.555 ***	N/A	5.148 ***
SSRIs Are Available	5.088 ***	8.681 ***	5.148 ***	N/A

Significant differences in availability of the medication by independent variables in bivariate logistic regression analysis,

* p<.05,

** p<.01,

*** p<.001 (two-tailed)

Table 3

Multivariate Logistic Regression Analyses of Availability of Medications on Organizational Characteristics (n = 665)

	Availability of Agonists b (S.E.)	Availability of Naltrexone b (S.E.)	Availability of Disulfiram b (S.E.)	Availability of SSRIs b (S.E.)
Center Type				
Government-Owned	.285 (.503)	.215 (.452)	.837 (.338)*	.525 (.299) ⁺
Public Non-Profit	Reference	Reference	Reference	Reference
Private Non-Profit	.301 (.425)	.690 (.353) ⁺	.292 (.313)	.456 (.267) ⁺
For-Profit	.489 (.470)	1.167 (.383)**	.764 (.341)*	.211 (.317)
Organizational Affiliation				
Hospital	.512 (.351)	.638 (.308)*	.963 (.296)**	.588 (.286)*
CMHC	.032 (.583)	.455 (.442)	.461 (.380)	.948 (.357)**
Freestanding	Reference	Reference	Reference	Reference
Center Age in Years	-.007 (.007)	.002 (.006)	-.005 (.006)	-.008 (.006)
Center Size in LN(FTEs)	.319 (.153)*	.030 (.125)	.067 (.113)	.165 (.110)
Accredited Center	1.373 (.363)***	.195 (.300)	-.213 (.273)	.331 (.233)
12-Step Model	-.485 (.304)	.224 (.262)	-.476 (.224)*	-.367 (.207) ⁺
Offers Inpatient Detoxification	.150 (.347)	1.154 (.312)***	.634 (.297)*	.645 (.281)*
Offers Outpatient Detoxification	.984 (.353)**	.899 (.321)**	.947 (.296)**	.493 (.332)
Offers Inpatient Treatment	.551 (.338)	-.112 (.302)	-.179 (.279)	.301 (.257)
Offers Residential Care	-.785 (.325)*	-.074 (.278)	-.408 (.260)	.036 (.234)
Offers Outpatient Care	-.391 (.381)	.729 (.390) ⁺	.419 (.340)	-.375 (.281)
Physician Resources				
Physician(s) on Staff	1.223 (.469)**	.690 (.340)*	.600 (.300)*	1.108 (.267)***
Physician(s) on Contract	.748 (.500)	.600 (.352) ⁺	.557 (.301) ⁺	.751 (.267)**
No Physicians	Reference	Reference	Reference	Reference
% Master's-Level Counselors	-.003 (.004)	.007 (.004) ⁺	.006 (.003) ⁺	.018 (.003)***
% Certified Counselors	-.001 (.004)	-.003 (.003)	.006 (.003) ⁺	-.003 (.003)
% Primary Alcohol Clients	-.009 (.007)	.004 (.005)	.003 (.005)	.002 (.004)
% Primary Opiate Clients	.037 (.007)***	-.004 (.007)	.006 (.006)	.008 (.006)
Constant	-4.451 (.855)***	-4.532 (.712)***	-3.392 (.611)***	-2.311 (.513)***
McKelvey & Zavoina's R ²	.536	.357	.252	.385

⁺
p<.10,

*
p<.05,

**
p<.01,

p<.001 (two-tailed)

Table 4

Multivariate Models of Less Intensely Regulated Medication and Agonist Medication Availability on Organizational Characteristics (n = 665)

	Less Intensely Regulated(LIR) Medications b (S.E.)	Agonist Medications b (S.E.)
Center Type		
Government-Owned	.294 (.125) *	.193 (.302)
Public Non-Profit	Reference	Reference
Private Non-Profit	.234 (.121) +	.177 (.265)
For-Profit	.358 (.137) **	.268 (.298)
Organizational Affiliation		
Hospital	.407 (.125) **	.280 (.198)
Mental Health Center	.357 (.156) *	-.039 (.405)
Freestanding	Reference	Reference
Center Age in Years	-.002 (.002)	-.004 (.004)
Center Size in LN(FTEs)	.045 (.047)	.185 (.084) *
Accredited Center	.064 (.110)	.756 (.220) ***
12-Step Model	-.135 (.090)	-.289 (.200)
Offers Inpatient Detoxification	.436 (.126) ***	.079 (.199)
Offers Outpatient Detoxification	.437 (.131) ***	.601 (.200) **
Offers Inpatient Treatment	.002 (.113)	.318 (.202)
Offers Residential Care	-.067 (.095)	-.418 (.182) *
Offers Outpatient Care	.076 (.133)	-.212 (.245)
Physician Resources		
Staff Physician(s)	.474 (.124) ***	.634 (.284) *
Contract Physician(s)	.375 (.124) **	.363 (.314)
No Physicians	Reference	Reference
% Master's-Level Counselors	.006 (.001) ***	-.001 (.003)
% Certified Counselors	.000 (.001)	-.001 (.002)
% Primary Alcohol Clients	.002 (.002)	-.004 (.004)
% Primary Opiate Clients	.002 (.002)	.021 (.005) ***
Latent Variable R ²	.495	
Relationship between LIR Medications and Agonist Medications		.217 (.050) ***
Weighted Root Mean Square Residual (WRMR)		.743
Root Mean Square Error of Approximation (RMSEA)		.027

+ p<.10,

* p<.05,

** p<.01,

*** p<.001 (two-tailed)