A Longitudinal Examination of Alcohol Pharmacotherapy Adoption in Substance Use Disorder Treatment Programs: Patterns of Sustainability and Discontinuation*

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ABSTRACT. Objective: The objectives of this study were to (a) identify the patterns of disulfiram (Antabuse) and tablet naltrexone (Revia) adoption over a 48-month period in a nationally representative sample of privately funded programs that deliver substance use disorder treatment; (b) examine predictors of sustainability, later adoption, discontinuation, and nonadoption of disulfiram and tablet naltrexone; and (c) measure reasons for medication discontinuation. **Method:** Two waves of data were collected via face-to-face structured interviews with 223 program administrators. **Results:** These data demonstrated that adoption of medications for alcohol use disorders (AUDs) was a dynamic process. Although nonadoption was the most common pattern, approximately 20% of programs sustained use of the AUD medications and 30% experienced organizational change in adoption over the study period. Bivariate multinomial logistic regression models revealed that organizational

characteristics were associated with sustainability including location in a hospital setting, program size, accreditation, revenues from private insurance, referrals from the criminal justice system, number of medical staff, and use of selective serotonin reuptake inhibitors at baseline. Two patterns of discontinuation were found: Programs either discontinued use of all substance use disorder medications or replaced disulfiram/tablet naltrexone with a newer AUD medication. **Conclusions:** These findings suggest that adoption of AUD medications may be positively affected by pressure from accreditation bodies, partnering with primary care physicians, medication-specific training for medical staff, greater availability of resources to cover the costs associated with prescribing AUD medications, and amending criminal justice contracts to include support for AUD medication use. (*J. Stud. Alcohol Drugs*, 72, 669–677, 2011)

OVER THE PAST DECADE, U.S. federal agencies have promoted increased use of medications in the treatment of patients with substance use disorders (SUDs) through the dissemination of practice guidelines and recent research initiatives (e.g., Center for Substance Abuse Treatment, 1998; National Institute on Alcohol Abuse and Alcoholism, 2005; National Institute on Drug Abuse [NIDA], 1999; West et al., 1999). These efforts include the Robert Wood Johnson Foundation's Advancing Recovery initiative, the Blending Initiative materials of NIDA and Substance Abuse and Mental Health Services Administration, and the release of Treatment Improvement Protocol 49 (*Incorporating Alcohol Pharmacotherapies Into Medical Practice*), a best-practice guideline for incorporating the use of the four Food and

Drug Administration (FDA)-approved alcohol pharmacotherapies into routine treatment for patients with alcohol use disorders (AUDs; NIDA, 2010; Center for Substance Abuse Treatment, 2009; Robert Wood Johnson Foundation, 2010). Despite these efforts, the use of medications for the treatment of AUDs in SUD treatment settings remains low (Abraham et al., 2010; Ducharme et al., 2006; Harris et al., 2010; Knudsen et al., 2011).

Although a growing body of research has been published that examines the availability of AUD pharmacotherapies using cross-sectional data (Ducharme et al., 2006; Fuller et al., 2005; Heinrich and Hill, 2008; Knudsen et al., 2005, 2007; Oser and Roman, 2007, 2008), few studies have examined patterns in the adoption of these medications over time in the specialty treatment system. Cross-sectional data provide a snapshot of medication availability in a given year but do not allow for an examination of changes in adoption behavior over time. For instance, data from the National Survey of Substance Abuse Treatment Services reveal that 11.0% of programs reported using tablet naltrexone (Revia) in 2004 and 15.4% reported using the medication in 2008 (Substance Abuse and Mental Health Services Administration, 2004, 2008). What appears to be a modest increase in availability of tablet naltrexone may actually mask more dynamic patterns of change. For instance, the overall increase in tablet naltrexone use may reflect both new adopters and programs that discontinued use rather than new adopters of tablet naltrexone only. Longitudinal panel data offer the

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opportunity to consider the availability of AUD medications through the lens of diffusion theory (Rogers, 2003), measuring dynamic processes of new adoption, sustainability, and discontinuation.

To address this gap in the literature, this study uses longitudinal data from a national sample of privately funded treatment programs to examine adoption of disulfiram (Antabuse) and tablet naltrexone over a 48-month period. Analyses are limited to disulfiram and tablet naltrexone because these were the only medications the FDA approved for the treatment of AUDs at baseline. Instead of focusing solely on availability (i.e., current use) of medications, this article examines a broader range of adoption behaviors including sustainability, discontinuation, and persistent nonadoption.

Disulfiram and tablet naltrexone

For nearly 40 years, disulfiram was the only medication with FDA approval for the treatment of alcohol dependence. Clinical trials of disulfiram therapy have shown mixed results, in part because of the challenges in achieving high levels of patient adherence. There is some evidence that strategies of patient monitoring, such as direct observation of dosing, may improve clinical outcomes (Brewer et al., 2000; Chick et al., 1992; Fuller and Gordis, 2004; Suh et al., 2006).

In 1994, the FDA approved the tablet formulation of naltrexone for treating alcohol-dependent patients. A recent Cochrane Review concluded that naltrexone was effective and safe (Rösner et al., 2010). Naltrexone was associated with reductions in the risk of heavy drinking, numbers of drinking days and heavy drinking days, and the amount of alcohol consumed per drinking day (Bouza et al., 2004; O'Malley et al., 1992; Rösner et al., 2010; Srisurapanont and Jarusuraisin, 2005; Volpicelli et al., 1992, 1995). Similar to disulfiram, patient compliance with tablet naltrexone has been problematic in clinical trials (Baros et al., 2007; Volpicelli et al., 1997).

Although both medications may be beneficial for some patients, neither of these medications is considered a "blockbuster" treatment for patients with AUDs, which may contribute to their low rates of adoption in specialty treatment programs. Data collected from a sample of privately funded SUD treatment programs in 2000–2001 indicated that 44% used naltrexone and 49% used disulfiram (Knudsen et al., 2005; Roman and Johnson, 2002), but this may have been the peaks of availability because data collected 4 years later revealed reductions in the percentage of programs offering both medications (Ducharme et al., 2006).

Cross-sectional studies on the adoption of disulfiram and tablet naltrexone

The majority of studies examining the organizational characteristics associated with the availability of disulfiram

and naltrexone for the treatment of AUDs have relied on cross-sectional data. Consistent with diffusion theory (Rogers, 2003), this body of research has identified a number of organizational factors associated with the availability of these medications (Ducharme et al., 2006; Fuller et al., 2005; Heinrich and Hill, 2008; Knudsen et al., 2005, 2007; Oser and Roman, 2007, 2008). Larger treatment programs are more likely to offer tablet naltrexone, perhaps as a result of greater slack resources (i.e., availability of additional resources beyond those required for ongoing operations) that can be devoted to implementing this medication (Fuller et al., 2005; Heinrich and Hill, 2008; Roman and Johnson, 2002). Programs located in hospital settings (an indicator of medical infrastructure support) are more likely to use both AUD medications (Knudsen et al., 2005, 2007). Programs with a treatment culture receptive to the use of medications, such as those that place less emphasis on 12-step models (which are traditionally not supportive of medication use), are more likely to offer both medications (Knudsen et al., 2005; Oser and Roman, 2008). Additionally, greater program revenues from private insurance are associated with adoption of disulfiram and tablet naltrexone (Ducharme et al., 2006; Roman and Johnson, 2002). Staff professionalization (i.e., greater percentage of counselors with master's degrees or higher) and access to medical staff (i.e., prescribing physicians) also facilitate adoption of disulfiram and tablet naltrexone (Ducharme et al., 2006; Fuller et al., 2005; Knudsen et al., 2005, 2007; Roman and Johnson, 2002). Finally, programs with a higher percentage of referrals from the criminal justice system are less likely to adopt tablet naltrexone because criminal justice contracts often do not include medications (Ducharme et al., 2006).

Longitudinal studies on the adoption of disulfiram and tablet naltrexone

A scant body of research examines the adoption of disulfiram or tablet naltrexone over time in specialty SUD treatment programs (Abraham et al., 2010; Ducharme et al., 2006; Oser and Roman, 2007). A study by Ducharme and colleagues (2006) found a significant decrease in the percentage of privately funded treatment programs using disulfiram, with rates declining from 51.6% in 1994 to 35.7% in 2004. Use of tablet naltrexone also significantly decreased over the study period, from 49.2% to 41.7%. However, this study did not examine the organizational correlates of medication sustainability, discontinuation, or nonadoption.

Oser and Roman (2007) used discrete-time event history analysis to examine tablet naltrexone adoption in privately funded programs from 1994 to 2003. Event history analysis essentially estimates the time to a specified event; in this case, the event was defined as first use of tablet naltrexone. The authors found that a 12-step treatment culture was negatively associated with the odds of adopting naltrexone.

For-profit programs, programs that used other prescription medications, and accredited programs were more likely to adopt tablet naltrexone during the study period. Although informative, the study did not consider patterns of adoption over the study period, such as sustainability and discontinuation, because the model addressed only time to initial adoption.

Finally, we recently examined adoption of tablet naltrexone over time in a matched sample of publicly funded treatment programs participating in the NIDA Clinical Trials Network (CTN) and non-CTN programs (Abraham et al., 2010). Compared with non-CTN programs, a greater percentage of CTN programs were sustainers and recent adopters of tablet naltrexone. Furthermore, fewer CTN programs discontinued use of the medication or were nonadopters of the medication over the 2-year study period. Although the study examined longitudinal patterns of adoption, reasons for discontinuation and nonadoption were not examined.

This article examines the adoption of disulfiram and tablet naltrexone for the treatment of AUDs using longitudinal data from a nationally representative sample of privately funded treatment programs, which are more likely to offer SUD medications compared with the public treatment sector (Ducharme et al., 2006). The study had three objectives: (a) identify the patterns of disulfiram and tablet naltrexone adoption over the study period; (b) examine predictors of sustainability, later adoption, discontinuation, and nonadoption of disulfiram and tablet naltrexone; and (c) determine why programs discontinued use of medications at 48-month follow-up.

Method

Data were drawn from two waves of a nationally representative longitudinal study of privately funded SUD treatment programs, which are part of the National Treatment Center Study. The wave of baseline data was collected from early 2002 to mid-2004; the follow-up wave of data was collected from early 2007 to late 2008. Programs were selected via a two-stage random sampling design, which is fully described in Abraham and Roman (2010) and Oser and Roman (2007).

The definition of private programs was designed to construct a sample of organizations that engaged in competitive and entrepreneurial behaviors. To be eligible for the study, programs were required to receive at least 50% of their annual operating revenues from commercial insurance, patient fees, and income sources other than "block" funding such as government grants or contracts. Medicaid and Medicare revenues were not regarded as block funding because these reimbursements are not assured but are dependent on particular patients being admitted for treatment. All programs were also required to offer alcohol and drug treatment at a level of intensity at least equivalent to American Society

of Addiction Medicine Level 1 outpatient services (Mee-Lee et al., 1996). Counselors in private practice, halfway houses, transitional living facilities, programs exclusively offering methadone maintenance, court-ordered driver education classes, detoxification-only services, and programs located in correctional and Veterans Health Administration facilities were ineligible for the study. Programs received a \$100 honorarium for participation in the study. All research procedures were approved by the University of Georgia's institutional review board.

Baseline data were collected via face-to-face interviews with program administrators, with an average time between interviews of 48 months. At baseline, 403 program administrators were interviewed, representing 88% of eligible programs. At follow-up, 37 programs had closed and 49 no longer met the funding and American Society of Addiction Medicine eligibility criteria, resulting in a pool of 317 eligible programs. Interviews were completed with 223 program administrators, representing a 70% response rate. Comparisons of the organizational characteristics of responders versus nonresponders (not shown) indicated no significant differences.

Measures

To represent the dynamic nature of innovation adoption over time, we organized programs into four-category typologies of disulfiram and tablet naltrexone adoption over the 4-year study period (Abraham et al., 2010; Knudsen et al., 2009). For each medication, programs were coded as follows: (a) *sustainers*, or programs that used the medication at baseline and continued to use the medication at 48-month follow-up; (b) *later adopters*, defined as programs that were nonadopters at baseline but adopted the medication by 48-month follow-up; (c) *nonadopters*, or programs that did not use the medication at either time point; or (d) *discontinuers*, defined as programs that used the medication at baseline but had discontinued use at 48-month follow-up. This categorical variable served as the dependent variable in a series of bivariate multinomial logistic regression models.

Consistent with diffusion theory and prior research on AUD pharmacotherapy adoption, several organizational characteristics measured at baseline were examined in the bivariate multinomial regression models. Profit status (1 = for profit, 0 = nonprofit) and location in a hospital (1 = hospital based, 0 = freestanding) were dichotomous measures. Organizational size was measured by the number of full-time-equivalent employees. This measure was natural log transformed to adjust for skew. Accreditation was a dichotomous measure that denoted whether programs were accredited by the Joint Commission or the Commission on Accreditation of Rehabilitation Facilities (1 = accredited, 0 = not accredited). The percentage of revenues from private insurance and the percentage of referrals from the criminal

justice system were continuous measures. Twelve-step treatment culture differentiated programs that required patients to attend 12-step meetings (coded "1") from programs that did not require 12-step meeting attendance (coded "0"). Number of medical staff was a continuous measure that summed the number of physicians and nurses on the center's payroll. We also included a dichotomous measure of selective serotonin reuptake inhibitor (SSRI) use at baseline (1 = prescribed SSRIs at baseline). A dichotomous measure indicated whether programs participated in research involving patients in the past 2 years (1 = participated in research in the past 2 years).

Finally, we measured reasons for discontinuation of disulfiram and tablet naltrexone. Programs that reported no use of SUD medications at follow-up were asked to identify the primary reason(s) they did not prescribe any SUD medications. Administrators at programs that continued to prescribe other SUD medications at follow-up were asked to identify the primary reasons they discontinued use of disulfiram and/or tablet naltrexone.

Statistical analysis

Several analytical techniques were used. First, descriptive statistics were calculated for all baseline measures. Second, a series of bivariate multinomial logistic regression models predicting the typologies of adoption of disulfiram and tablet naltrexone was estimated. Because of the small number of cases in some of the adopter categories, we were unable to estimate multivariate models. Missing data on the independent variables were addressed through multiple imputation procedures using the *mi* command suite in Stata 11.0 (StataCorp LP, College Station, TX; Allison, 2002; Royston, 2005). Finally, responses to open-ended questions regarding discontinuation of disulfiram and tablet naltrexone were coded into relevant categories.

Results

Descriptive statistics

Sample characteristics. Baseline descriptive statistics are shown in Table 1. To assess patterns of adoption over the study period, programs were classified into the four adopter categories—sustainers, later adopters, discontinuers, and nonadopters—for disulfiram and tablet naltrexone, respectively. This typology revealed that 16.6% of programs were early adopters of disulfiram who sustained use over time, 13.0% were later adopters, 15.2% discontinued use of disulfiram, and 55.2% were consistent nonadopters of this medication. The distribution for tablet naltrexone was similar: 19.3% of programs were earlier adopters, 17.9% were later adopters, 12.6% discontinued use of tablet naltrexone, and 50.2% of programs were nonadopters. In other words, about 28.3% of programs experienced organizational change between

TABLE 1. Descriptive statistics ($N = 223$)

Variable	% (n) or M (SD)
For profit	31.2% (70)
Hospital based	48.0% (107)
Program size	2.87 (1.25)
Accredited	71.3% (159)
Revenues from private insurance	20.98% (25.02)
Referrals from the legal system	22.07% (25.79)
12-Step attendance required	70.0% (156)
No. of medical staff (nurses, physicians)	9.91 (15.40)
Use SSRIs	61.0% (136)
Participated in research	42.1% (94)

Note: SSRI = selective serotonin reuptake inhibitor.

the two time points for disulfiram, whereas 30.5% reported organizational change for tablet naltrexone.

Results of bivariate multinomial logistic regression models

We estimated a series of bivariate multinomial logistic regression models to examine relationships between each organizational characteristic and the typology of adoption. Given the four categories in the typology, six pairwise comparisons were possible. However, organizational characteristics were not associated with the odds of disulfiram sustainability relative to the odds of later adoption, nor did organizational characteristics differentiate discontinuers from later adopters (results not shown). Therefore, Table 2 presents four of the six possible comparisons from the multinomial logistic regression models predicting adoption of disulfiram.

Several of the organizational characteristics were significantly associated with the typology of disulfiram adoption. First, the odds of being a disulfiram sustainer versus a nonadopter were greater for programs based in hospital settings. There was a positive association between organizational size and the odds of sustained adoption, relative to the odds of nonadoption, such that larger programs were more likely to be sustained adopters. Program accreditation not only differentiated sustained adopters and later adopters from nonadopters, but it was also protective against discontinuation. Accredited programs were more likely than nonaccredited programs to be sustainers or later adopters, relative to the odds of being a nonadopter. Furthermore, accredited programs were more likely to be sustainers than discontinuers.

Reliance on revenues from private insurance also showed a significant relationship with the adopter typology. Programs receiving a greater percentage of their revenues from private insurance were more likely to be sustained adopters than nonadopters. However, greater reliance on private insurance was also a risk factor for being a discontinuer versus a nonadopter. In part, this relationship likely reflects that pro-

TABLE 2. Bivariate multinomial logistic regressions of disulfiram adoption

Variable	Sustainer vs. nonadopter <i>b</i> (<i>SE</i>) and RRR [95% CI]	Discontinuer vs. nonadopter <i>b</i> (<i>SE</i>) and RRR [95% CI]	Later adopter vs. nonadopter <i>b</i> (<i>SE</i>) and RRR [95% CI]	Sustainer vs. discontinuer <i>b</i> (<i>SE</i>) and RRR [95% CI]
For profit	-0.230 (0.418) 0.795 [0.350, 1.803]	0.157 (0.408) 1.170 [0.526, 2.604]	-0.202 (0.459) 0.817 [0.333, 2.008]	-0.387 (0.516) 0.678 [0.247, 1.865]
Hospital	1.375 (0.405)** 3.957 [1.789, 8.752]	0.752 (0.392) 2.212 [0.983, 4.576]	0.723 (0.417) 2.060 [0.909, 4.668]	0.624 (0.499) 1.866 [0.702, 4.959]
Size	0.332 (0.156)* 1.393 [1.025, 1.893]	-0.026 (0.160) 0.974 [0.713, 1.332]	0.301 (0.156) 1.3518 [0.963, 1.894]	0.358 (0.197) 1.430 [0.972, 2.105]
Accredited	1.571 (0.562)** 4.810 [1.598, 14.471]	0.185 (0.414) 1.203 [0.534, 2.710]	1.293 (0.571)* 3.644 [1.191, 11.148]	1.386 (0.645)* 3.998 [1.129, 14.154]
% Revenues from private insurance	0.033 (0.008)** 1.034 [1.018, 1.050]	0.028 (0.007)** 1.028 [1.014, 1.043]	0.014 (0.008) 1.014 [0.999, 1.029]	0.006 (0.008) 1.006 [0.990, 1.022]
% Referrals from the criminal justice system	-0.037 (0.013)** 0.964 [0.940, 0.988]	-0.004 (0.008) 0.996 [0.981, 1.011]	-0.009 (0.009) 0.992 [0.974, 1.009]	-0.033 (0.014)* 0.967 [0.941, 0.994]
12-Step attendance required	-0.109 (0.402) 0.896 [0.407, 1.973]	0.489 (0.469) 1.631 [0.650, 4.092]	-0.092 (0.451) 0.912 [0.377, 2.209]	-0.599 (0.552) 0.549 [0.186, 1.621]
No. of medical staff	0.050 (0.014)** 1.051 [1.024, 1.080]	0.025 (0.016) 1.025 [0.993, 1.058]	0.042 (0.015)** 1.043 [1.014, 1.073]	0.026 (0.015) 1.026 [0.995, 1.057]
Use SSRIs	1.89 (0.482)** 6.602 [2.569, 16.997]	0.602 (0.393) 1.835 [0.845, 3.943]	1.589 (0.493)** 4.898 [1.863, 12.876]	1.286 (0.566)* 3.617 [1.193, 10.967]
Participated in research	0.113 (0.381) 1.119 [0.531, 2.361]	-0.374 (0.403) 0.688 [0.312, 1.514]	-0.410 (0.431) 0.664 [0.285, 1.545]	0.487 (0.491) 1.627 [0.622, 4.258]

Notes: **Bold** indicates statistical significance. RRR = relative risk ratio; 95% CI = 95% confidence interval; SSRI = selective serotonin reuptake inhibitor.

* $p < .05$; ** $p < .01$.

grams receiving more of their revenues from private insurance were more likely to have adopted disulfiram at baseline, which then put them “at risk” of later discontinuation.

Percentage of referrals from the criminal justice system appeared to be a barrier to sustained adoption. Receiving a higher percentage of criminal justice referrals was associated with lower odds of being a sustainer versus a nonadopter. In addition, these criminal justice referrals were negatively associated with the odds of being a sustainer when compared with the odds of being a discontinuer.

Access to medical staff and use of SSRIs at baseline were both associated with the adoption typology. Compared with the odds of nonadoption, the odds of being a later adopter or a sustainer of disulfiram were greater for programs with more medical staff. Availability of SSRIs was associated with sustained adoption of disulfiram (relative to both nonadoption and discontinuation). Finally, the odds of being a later adopter were greater for programs that used SSRIs at baseline relative to the odds of being a nonadopter throughout the study period.

Table 3 displays bivariate multinomial regression models predicting adoption of tablet naltrexone. We found no significant differences in the odds of being a discontinuer versus a sustainer, the odds of being a later adopter versus a sustainer, or the odds of being a later adopter versus a discontinuer (results not shown). Results were generally similar to those of the disulfiram models. Hospital setting, program size, accreditation, number of medical staff, percentage of revenues from private insurance, and use of SSRIs were significantly

associated with the adopter typology. The odds of being a discontinuer, later adopter, or sustainer relative to the odds of being a nonadopter were lower for programs with a greater percentage of referrals from the criminal justice system. The odds of being a later adopter were greater for programs that participated in research relative to the odds of being a nonadopter over the study period.

Discontinuation of medications

In total, 34 (47.9%) of the 71 programs that used disulfiram at baseline discontinued use of the medication, whereas 28 (39.4%) of the 71 programs that used tablet naltrexone at baseline discontinued its use over the 48-month study period. Data on discontinuation were examined separately for programs that discontinued use of all SUD medications ($n = 16$) at follow-up and programs that continued to use other SUD medications at follow-up ($n = 18$). We identified general reasons for not using any medications for the former group of programs and specific reasons for discontinuation of disulfiram or tablet naltrexone for the latter group.

Disulfiram discontinuation. At follow-up, about half ($n = 16$) of the treatment programs that discontinued the use of disulfiram stopped use of all medications for the treatment of SUDs. Seven of these 16 programs no longer employed a physician at the 48-month follow-up. Among the remaining nine programs, the following were cited as important reasons for discontinuing SUD medications: changes in state regulations that prohibited the program from prescribing medica-

TABLE 3. Bivariate multinomial logistic regressions of tablet naltrexone adoption

Variable	Sustainer vs. nonadopter <i>b</i> (SE) and RRR [95% CI]	Discontinuer vs. nonadopter <i>b</i> (SE) and RRR [95% CI]	Later adopter vs. nonadopter <i>b</i> (SE) and RRR [95% CI]
For profit	-0.140 (0.381) 0.869 [0.412, 1.832]	-0.511 (0.479) 0.600 [0.235, 1.534]	-0.784 (0.443) 0.457 [0.192, 1.089]
Hospital	0.823 (0.367)* 2.277 [1.110, 4.672]	0.686 (0.428) 1.985 [0.858, 4.591]	0.398 (0.370) 1.489 (0.720, 3.077)
Size	0.482 (0.156)** 1.619 [1.193, 2.196]	0.153 (0.178) 1.165 [0.821, 1.652]	0.481 (0.160)** 1.618 [1.182, 2.216]
Accredited	1.432 (0.481)** 4.188 [1.631, 10.753]	0.892 (0.503) 2.441 [0.911, 6.538]	1.164 (0.459)** 3.202 [1.301, 7.876]
% Revenues from private insurance	0.023 (0.007)** 1.024 [1.009, 1.040]	0.015 (0.007)* 1.020 [1.005, 1.034]	0.007 (0.007) 1.011 [0.998, 1.024]
% Referrals from the criminal justice system	-0.053 (0.015)** 0.948 [0.921, 0.976]	-0.033 (0.012)** 0.969 [0.950, 0.989]	-0.032 (0.010)** 0.967 [0.945, 0.990]
12-Step attendance required	0.149 (0.398) 1.161 [0.533, 2.5311]	1.003 (0.577) 2.727 [0.880, 8.455]	-0.202 (0.392) 0.817 [0.379, 1.761]
No. of medical staff	0.047 (0.014)** 1.048 [1.019, 1.078]	0.017 (0.020) 1.017 [0.978, 1.057]	0.050 (0.014)** 1.052 [1.022, 1.082]
Use SSRIs	2.148 (0.457)** 8.571 [3.501, 20.987]	2.037 (0.531)** 7.667 [2.710, 21.691]	1.242 (0.390)** 3.462 [1.612, 7.433]
Participated in research	0.243 (0.369) 1.275 [0.619, 2.628]	0.246 (0.430) 1.275 [0.619, 2.628]	0.734 (0.374)* 2.084 [1.002, 4.337]

Notes: **Bold** indicates statistical significance. RRR = relative risk ratio; 95% CI = 95% confidence interval; SSRI = selective serotonin reuptake inhibitor.

* $p < .05$; ** $p < .01$.

tions ($n = 5$), concerns over legal liability ($n = 3$), and the belief that medications were inconsistent with their treatment philosophy ($n = 1$).

Among the remaining 18 treatment programs that continued to prescribe other SUD medications, the most common reasons for discontinuation of disulfiram were availability of better medications for treatment of AUDs ($n = 7$), perception of disulfiram as ineffective and/or unsafe ($n = 4$), the program physician's preference not to use disulfiram ($n = 4$), loss of the physician who prescribed disulfiram ($n = 1$), relapse potential of patients ($n = 1$), and lack of patient requests for this medication ($n = 1$).

We also examined whether these 18 treatment programs engaged in replacement discontinuation in which disulfiram was replaced with tablet naltrexone, acamprosate (Campral), or injectable naltrexone (Vivitrol). In this subset of programs, 13 programs (72%) replaced disulfiram with another AUD medication. Two treatment programs adopted both tablet naltrexone and acamprosate, four programs adopted acamprosate only, two programs adopted injectable naltrexone only, and five programs adopted both acamprosate and injectable naltrexone.

Tablet naltrexone discontinuation. At follow-up, 14 programs that discontinued use of tablet naltrexone reported discontinuing the use of all medications for SUDs. Of these 14 treatment programs, 4 no longer employed any physicians at follow-up. Among the remaining 10 programs, the following were cited as important reasons for discontinuing SUD medications: changes in state regulations that prohibited them from prescribing medications ($n = 3$), concerns

about legal liability ($n = 3$), difficulty getting reimbursed for medications ($n = 2$), medications were too expensive for patients ($n = 1$), and medications were inconsistent with their treatment philosophy ($n = 1$).

Among the 14 programs that discontinued use of tablet naltrexone and continued to prescribe other SUD medications, the most commonly cited reasons for discontinuation were that the program physician preferred not to use tablet naltrexone ($n = 4$), loss of the physician who prescribed tablet naltrexone ($n = 1$), the perception that tablet naltrexone was ineffective and/or unsafe ($n = 4$), a perceived lack of need for the medication ($n = 1$), and lack of patient requests for naltrexone ($n = 1$). Three programs could not articulate a clear reason for discontinuation.

Again, we examined the phenomena of replacement discontinuation. Nine of the 14 programs (64%) replaced tablet naltrexone with another AUD medication. Six programs adopted acamprosate, two programs adopted injectable naltrexone, and one program adopted both acamprosate and injectable naltrexone. No programs replaced tablet naltrexone with disulfiram.

Discussion

This study examined changes in the use of innovations over time in a sample of privately funded SUD treatment programs, focusing on disulfiram and tablet naltrexone for the treatment of AUDs. Our results revealed that a majority of programs were nonadopters of both medications over the 48 months of the study. This finding is striking considering

the efforts to promote adoption of pharmacotherapies by agencies at several levels of government, as well as among leadership in the field of SUD treatment. However, when compared with the percentage of nonadopters of tablet naltrexone in the public sector (86.1%), private sector programs were less likely to be nonadopters (50.2%; Abraham et al., 2010).

An often-cited barrier to medication adoption in SUD treatment is lack of access to physicians (Ducharme et al., 2006; Knudsen et al., 2010, 2011; McLellan et al., 2003). For both medications, we found that greater access to medical personnel was positively associated with the odds of being either a sustainer or a later adopter, relative to the odds of being a nonadopter. However, more than 70% of these nonadopting programs had access to at least one physician at the time of the 48-month follow-up interview. These findings show very clearly that having a physician on staff is not a sufficient condition for adoption of medications. In fact, a 2003 study showed that only 9% of physicians working in the SUD treatment field prescribed disulfiram and 13% prescribed tablet naltrexone (Mark et al., 2003).

Future research should examine why such programs with physicians on staff are not using medications to treat AUDs. Part of the explanation likely resides in physician preferences. Specifically, physicians may be opposed to the use of SUD medications in general, may have developed negative evaluations of specific medications based on their own reading and continuing education, or may have had unsuccessful experiences with AUD medications. Physicians may also lack the training to feel comfortable with using AUD medications. Further, it might be a mistake to assume that physicians working in SUD treatment programs have total autonomy in deciding about medication use because decisions against use may come from administrators or other clinical leadership in the organization.

Although our data on medication discontinuation revealed that physician preferences may be one reason for nonuse in some treatment settings, other barriers likely remain. Funding policies might represent a critical barrier to adoption if funding entities, such as Medicaid and private insurance plans, will not cover the costs associated with prescribing medications or they set high co-payments for these medications (Horgan et al., 2008; Thomas et al., 2011). A recent study found that funding policies, particularly those that do not allow reimbursement for costs associated with medications, were a major barrier to adoption among publicly funded programs (Knudsen et al., in press). In the subset of programs that offered no medications for SUDs, nearly 80% indicated that state regulations prohibiting adoption because of their lack of medical staff was an important reason for nonadoption. Funding policies that would not pay for the costs of purchasing medications (71%) or for physician time (62%) were also important

barriers to adoption. Major changes in funding policies may be necessary to facilitate greater use of AUD medications because the cost of implementing use of pharmacotherapies can be substantial for treatment programs (e.g., physician time, laboratory tests).

Although nonadoption was the most prevalent adoption pattern, these analyses show that medication use is dynamic in the privately funded SUD treatment sector and is not simply moving along a slow but steady upward curve. Approximately 30% of programs experienced organizational change related to disulfiram and tablet naltrexone over the study period by either discontinuing or newly adopting one of these AUD medications.

Our findings about discontinuation are particularly salient because these data are some of the first to measure this phenomenon within SUD treatment programs, and our data suggest that there are two major patterns of discontinuation. Some programs discontinued use of all SUD medications, including disulfiram and tablet naltrexone, over time. This total discontinuation of all SUD medications was attributed primarily to loss of physicians, state regulations, or concerns over legal liability. The other subset of programs replaced disulfiram or tablet naltrexone with a newer AUD medication, such as acamprosate or injectable naltrexone. This phenomenon of replacement following discontinuation suggests that the continued development of new and more effective AUD medications may spur greater adoption in some treatment programs.

Although disulfiram and tablet naltrexone are not “new” AUD medications, some programs continue to adopt these medications for AUD treatment, as evidenced by the 13% of later adopters of disulfiram and the 18% of later adopters of tablet naltrexone over the study period. This rate of later adoption is considerably more robust than our recent finding that just 5.7% of publicly funded programs are later adopters of tablet naltrexone (Abraham et al., 2010).

Finally, fewer than 20% of programs sustained use of either AUD medication over the study period. Sustainability of disulfiram and tablet naltrexone was associated with a number of organizational characteristics. Consistent with earlier cross-sectional studies of adoption (Knudsen et al., 2005, 2007), programs located in hospital settings were significantly more likely to be sustainers of disulfiram and tablet naltrexone over the study period. The number of medical staff and use of SSRIs at baseline were also positive predictors of sustainability. These findings indicate that medical infrastructure and access to medical personnel and resources play a key role in sustainability of AUD medications. Continued efforts are needed to better integrate medical staff and resources into SUD treatment programs. Strategies for integration include partnering with local primary care physicians or local hospitals to provide medical services, including prescription of AUD medications. Leaders in the SUD field must also find ways to attract and retain physicians

and nurses with SUD training and expertise in treating this patient population.

The odds of being a sustainer of tablet naltrexone were greater for larger programs, indicating that availability of slack resources supports early and sustained adoption of these medications. This finding is consistent with prior cross-sectional adoption studies (Fuller et al., 2005; Heinrich and Hill, 2008; Roman and Johnson, 2002). These results suggest that smaller treatment programs may face a disadvantage in access to funding to support implementing pharmacotherapies. Treatment programs may therefore benefit from additional funding that specifically targets AUD medications.

The odds of being a sustainer of both medications were also greater for programs accredited by the Joint Commission or the Commission on Accreditation of Rehabilitation Facilities, a finding that is similar to an earlier longitudinal study of tablet naltrexone adoption in private sector programs (Oser and Roman, 2007). Additionally, the odds of disulfiram sustainability were greater for accredited programs relative to the odds of discontinuing use of disulfiram. These findings indicate that pressure from external organizations may promote sustained use of AUD medications and act as a protective mechanism against discontinuation. Given the influence of accreditation bodies on adoption of AUD medications, these agencies have the potential to positively affect sustainability of medications and other evidence-based practices by offering incentives for adoption or requiring use of medications as a condition of accreditation.

Program revenues from private insurance also played a key role in sustainability. Consistent with prior cross-sectional research (Ducharme et al., 2006; Roman and Johnson, 2002), programs with a greater percentage of revenues from private insurance were more likely to sustain use of both AUD medications. The recent parity and health care reform legislation promises more equitable SUD insurance coverage for Americans with private health insurance plans and coverage for dependent children up to age 26 through their parents' health insurance plans. Therefore, we may see an increase in use of AUD medications among persons with private health care insurance. However, the effects of this legislation on the provision of SUD treatment services remain to be seen.

Finally, programs with a higher percentage of referrals from the criminal justice system were less likely to sustain use of medications over time. This finding is consistent with a prior cross-sectional study of tablet naltrexone availability (Ducharme et al., 2006) and suggests that adoption and implementation could be positively affected if criminal justice contracts were amended to include medications. Such changes would require greater funding and policy change on the part of the government (e.g., providing incentives for criminal justice agencies to include medications in contracts), which admittedly may be difficult in the current economic climate.

Limitations

Several limitations of the current study should be noted. First, the low number of programs within the adopter categories precluded use of multivariate statistical techniques. Despite this limitation, this study provides a first look at variation in adoption behavior of disulfiram and naltrexone over time within treatment organizations. Second, the adoption of medications may occur at a more rapid pace than captured in the 4-year period between our waves of on-site data collection. More dynamic patterns of adoption may be missed by the study design; for example, a program that adopted a medication at baseline may have discontinued its use at some point but then began using the medication again by the time of the follow-up interview. Third, data were self-reported by the administrator of the treatment programs and are therefore subject to recall bias. Fourth, these findings are limited to the privately funded SUD treatment sector; caution is warranted before attempting to generalize these findings to programs that are largely funded through stable governmental sources, such as the federal block grants or state contracts to provide services for a fixed number of patients per year.

Conclusions

Our findings demonstrate the importance of examining patterns of innovation adoption over time. Results suggest that adoption and sustainability of AUD medications may be positively affected by pressure from accreditation bodies, partnering with primary care physicians, medication-specific training for medical staff, greater availability of resources to cover the costs associated with prescribing AUD medications, and amending criminal justice contracts to include support for AUD medication use.

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