Published in final edited form as:

J Subst Abuse Treat. 2009 October ; 37(3): 307–312. doi:10.1016/j.jsat.2008.12.004.

Buprenorphine adoption in the National Drug Abuse Treatment Clinical Trials Network

Hannah K. Knudsen, Ph.D.^{a,*}, Amanda J. Abraham^b, J. Aaron Johnson^b, and Paul M. Roman^{b,c}

^aDepartment of Behavioral Science and Center on Drug and Alcohol Research, University of Kentucky, 109 Medical Behavioral Science Building, Lexington, KY 40536-0086, USA

^bInstitute for Behavioral Research, University of Georgia, 111A Barrow Hall, Athens, GA 30602-2401, USA

^cDepartment of Sociology, 119 Baldwin Hall, The University of Georgia, Athens, GA 30602-1611, USA

Abstract

The National Drug Abuse Treatment Clinical Trials Network (CTN), a collaborative federal research initiative that brings together universities and community-based treatment programs (CTPs), has conducted multiple clinical trials of buprenorphine for opioid dependence. Part of the CTN's mission is to promote the adoption of evidence-based treatment technologies. Drawing on a data collected during face-to-face interviews with administrators from a panel of 206 CTPs, this research examines the adoption of buprenorphine over a 2-year period. These data indicated that the adoption of buprenorphine doubled between the baseline and 24-month follow-up interviews. Involvement in a buprenorphine protocol continued to be a strong predictor of adoption at the 2-year follow-up, although adoption of buprenorphine tripled among those CTPs without buprenorphine-specific protocol experience. For-profit CTPs and those offering inpatient detoxification services were more likely to adopt buprenorphine over time. A small percentage of programs discontinued using buprenorphine. These findings point to the dynamic nature of service delivery in community-based addiction treatment and the continued need for longitudinal studies of organizational change.

Keywords

Buprenorphine; Adoption of innovations; Clinical Trials Network; Health services research

1. Introduction

Since the publication of the Institute of Medicine's report *Bridging the gap between practice and research: Forging partnerships with community-based drug and alcohol treatment* (Lamb, Greenlick, & McCarty, 1998), there has been growing interest in the transfer of evidence-based

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*Corresponding author. Department of Behavioral Science and Center on Drug and Alcohol Research, University of Kentucky, 109 Medical Behavioral Science Building, Lexington, KY 40536-0086, USA. Tel.: +1 859 323 3947; fax: +1 859 323 5350. E-mail address: hannah.knudsen@uky.edu (H.K. Knudsen).

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treatment technologies into community-based treatment organizations. The National Drug Abuse Treatment Clinical Trials Network (CTN) is a large-scale federal initiative focused on the “research-to-practice gap.” The CTN has brought together university-based researchers and clinicians from community-based treatment programs (CTPs) for the two goals of conducting multisite clinical trials of treatment interventions in “real-world” treatment programs and encouraging the adoption of evidence-based treatment techniques in these settings (Hanson, Leshner, Tai, 2002; National Institute on Drug Abuse [NIDA], 2006). A significant focus of the CTN’s research agenda has been the use of buprenorphine (Suboxone; Reckitt Benckiser Pharmaceuticals) for treating opioid dependence in different types of treatment settings and patient populations. To date, six of the CTN’s studies have included buprenorphine as part of the protocol (Amass et al., 2004; Ling et al., 2005; Saxon & McCarty, 2005; <http://www.nida.nih.gov/CTN/Research.html>).

In earlier research, we found that organizational involvement in the CTN’s buprenorphine protocols increased the likelihood of buprenorphine adoption at a 6-month follow-up interview (Ducharme, Knudsen, Roman, Johnson, 2007). This finding was consistent with the innovation theory of Rogers (2003), who argued that “trialability” was an important feature of innovations. Specifically, Rogers noted that innovations are more likely to be adopted when they can be tried on a limited basis. Participation in the CTN’s buprenorphine protocols offered CTPs an opportunity to try a relatively new medication for opioid dependence. What is less clear is whether this protocol experience continues to be advantageous in terms of adoption over time or whether CTPs without protocol experience have been able to narrow the gap in adoption.

In addition, it is unknown whether the organizational characteristics associated with early adoption continue to be relevant in later adoption of buprenorphine. Previous studies have focused on the initial period of buprenorphine’s availability in the United States. Those earlier studies relied on cross-sectional data (Ducharme Abraham, 2008; Koch, Arfken, Schuster, 2006) or a 1-year follow-up period (Knudsen, Ducharme, Roman, 2006). Although those studies are suggestive of relevant organizational covariates, it is difficult to ascertain whether those characteristics continue to be associated with buprenorphine adoption over time. In particular, research to date has not been able to examine the transition from nonuse to adoption in a longitudinal panel of programs due to reliance on cross-sectional designs or longitudinal models without a control variable for whether programs were already using buprenorphine at baseline.

Drawing on baseline data and 24-month follow-up data, this research considers three questions. First, is there evidence of expanding adoption of buprenorphine in CTN-affiliated CTPs over time? Second, are the organizational characteristics correlated with early buprenorphine adoption at the baseline interview also associated with adoption at the 24-month follow-up? Finally, does there continue to be a significant difference between research-involved and non-involved CTPs in the likelihood of buprenorphine adoption over time?

2. Methods

2.1. Sample

Between late 2002 and mid 2004, all of the CTPs affiliated with NIDA’s CTN were contacted by telephone about participating in a longitudinal health services research project about the adoption of evidence-based treatment practices. At the time of baseline data collection, the CTN consisted of 17 research “nodes,” with each node consisting at least one university-based research center and several CTPs. At baseline, the CTN included 109 unique treatment provider organizations, in which 262 treatment centers were embedded. A treatment center was defined as an organizational unit having an autonomous administrator with discretionary control over the unit’s budget. To be eligible for this study, CTPs were required to provide a minimum level

of care at least equivalent to American Society of Addiction Medicine-defined outpatient services (Mee-Lee, Gartner, Miller, Shulman, Wilford, 1996) or methadone maintenance treatment. CTN-affiliated units that were dedicated to prevention/education/outreach services, correctional services, or assessment services were not eligible because these programs were unlikely to have direct involvement in CTN-related research protocols. During the baseline study period, face-to-face interviews were conducted with 241 administrators, yielding a response rate of 91.6%. Participating CTPs received an honorarium of US\$100.

Approximately 24 months later, the administrators of this cohort of 241 CTPs were recontacted by telephone and invited to participate in a second face-to-face interview. Of the 241 CTPs that participated in the baseline interview, 2.9% had ceased operations ($n = 7$) and 5.8% were ineligible because they were no longer affiliated with the CTN ($n = 14$), leaving a cohort of 220 programs eligible for follow-up. About 3.2% ($n = 7$) of programs refused to participate in this latter round of interviews, and 3.2% ($n = 7$) were unable to be contacted after repeated attempts. Of the 220 CTPs eligible to participate in the 24-month follow-up interview, 206 (93.6%) participated and received an honorarium of US \$100. All research procedures were approved by the University of Georgia's Institutional Review Board.

2.2. Measures

Adoption of buprenorphine was defined as current use of this medication by the CTP. This dichotomous variable (1 = adoption, 0 = non-adoption) was measured at baseline and at the 24-month follow-up interview. Based on these two waves of data, CTPs were also sorted into four categories at the 24-month follow-up interview: early adoption (used buprenorphine at baseline and continued to use at follow-up), later adoption (nonadopters at baseline, but adoption by the follow-up), nonadoption (did not use buprenorphine at either time point), and discontinuation (used buprenorphine at baseline, but no longer used at the follow-up).

Six organizational characteristics, measured during the baseline interview, are included in these analyses. First, CTPs were categorized as *publicly funded* (coded 1) if more than half of their past-year revenues came from governmental grants or contracts, such as funding via the state-administered federal block grant, contracts with state and local governments, and criminal justice funding. CTPs that received less than half of their revenues were considered to be privately funded (coded 0). The second organizational characteristic was *profit status*, which was coded 1 if the CTP operated on a for-profit basis and 0 for nonprofit organizations. *Organizational size* was measured as the number of full-time equivalent (FTE) employees; due to skew, this measure was log-transformed for modeling purposes. *Access to physicians* was a dichotomous variable, which differentiated CTPs with any physicians as employees or on contract (coded 1) from those with no formal access to physicians (coded 0). The availability of *inpatient detoxification* was a dichotomous variable (1 = offers detoxification, 0 = no inpatient detoxification). *Use of methadone* by the CTP for the treatment of opioid dependence was also measured (1 = uses methadone, 0 = does not use methadone).

Finally, *involvement in a CTN protocol related to buprenorphine* was measured at both the baseline and 24-month follow-up interviews. CTPs that had participated in at least one buprenorphine protocol were coded 1, whereas programs with no experience in the CTN's buprenorphine protocols were coded 0.

2.3. Analysis

Descriptive statistics were calculated for all variables. The analysis of buprenorphine adoption proceeded through two stages. First, bivariate logistic regression models of buprenorphine adoption at baseline were estimated using the six organizational characteristics and the measure of involvement in a CTN buprenorphine protocol; multivariate models were not estimated

because of the limited number of buprenorphine adopters at baseline. Complete data on these measures were available from 231 of the 240 baseline interviews. The second stage of data analysis involved the estimation of two multivariate logistic regression models of buprenorphine adoption as of the 24-month follow-up interview. The first model includes the organizational characteristics (measured at baseline) and the measure of protocol involvement (as of the 24-month follow-up interview). The second model adds a control variable for buprenorphine adoption at baseline. To consider the issue of multicollinearity, we used the diagnostic procedures suggested by Allison (1999); there was no evidence of multicollinearity between the independent variables (results available by request). Complete data from the 24-month interviews were available from 193 of the 206 interviews that were conducted.

3. Results

3.1. Baseline interview results

Organizational characteristics, measured at the baseline interview, revealed that slightly less than half (45.9%) of the CTPs affiliated with the CTN received the majority of their funding through government grants and contracts. The remaining 54.1% of CTPs reported that less than half of their revenues came from these governmental sources. Most CTPs were operated as nonprofit organizations, with only 12.6% of CTPs operating on a for-profit basis. The average CTP had 32.9 FTE employees ($SD = 40.9$). Most CTPs (72.3%) either employed or contracted with at least one physician. Only 18.6% of CTPs offered inpatient detoxification, whereas 39.0% reported that methadone was currently available for the treatment of opioid dependence. About 20.4% of CTPs had been involved in at least one CTN-related buprenorphine protocol.

At the baseline interview, about 15.6% of the CTPs ($n = 36$ of 231) indicated that they currently used buprenorphine. A series of bivariate logistic regression models were estimated to examine the types of organizations that were more likely to have adopted buprenorphine at baseline (Table 1). Adoption of buprenorphine at baseline was less likely to occur in CTPs that were predominantly funded through government grants and contracts, relative to CTPs that did not rely on these governmental sources of funding. Baseline adoption was significantly more likely in CTPs that were larger in size and had access to physicians. In addition, programs offering inpatient detoxification and methadone maintenance were more likely to have adopted buprenorphine at baseline. However, the strongest bivariate correlate of baseline adoption was involvement in the CTN's buprenorphine protocols (odds ratio = 9.100, $p < .001$). At the baseline interview, buprenorphine had been adopted by 44.7% of CTPs with protocol experience, compared to just 8.2% of CTPs without protocol experience ($\chi^2 = 38.0$, $df = 1$, $p < .001$).

3.2. 24-Month follow-up results

By the 24-month follow-up interview, adoption of buprenorphine had doubled, increasing to 31.6% ($n = 61$ of 193) of CTPs affiliated with the CTN. The four-category typology of adoption at the 24-month follow-up revealed that about 11.4% ($n = 22$) of the CTPs could be characterized as early adopters, meaning that they had adopted buprenorphine at baseline and sustained that adoption as of the 24-month follow-up. An additional 20.2% ($n = 39$) of the CTPs were later adopters, meaning that they were not using buprenorphine at baseline but adopted it during the 2-year follow-up period. About 5.7% ($n = 11$) of the CTPs had discontinued use of buprenorphine by the follow-up interview, and 62.7% ($n = 121$) did not report using buprenorphine at either interview.

There continued to be a strong difference in adoption between CTPs with buprenorphine-specific protocol experience and those without such experience. At the 24-month follow-up, 54.4% of CTPs with such protocol experience had adopted buprenorphine, compared to 24.5%

of CTPs without buprenorphine protocol experience ($\chi^2 = 14.4$, $df = 1$, $p < .001$, two-tailed test). Despite this difference, it is important to note that adoption tripled among CTPs without protocol experience between baseline and the follow-up. In contrast, the percentage of adopting CTPs among those with buprenorphine protocol experience only increased by about 9.7 percentage points.

Table 2 presents multivariate logistic regression models of adoption of buprenorphine at the 24-month follow-up interview. The first model includes organizational characteristics at baseline as well as buprenorphine protocol experience as of the 24-month follow-up. Four variables were statistically significant. After controlling for the other organizational characteristics, CTPs with experience in a buprenorphine protocol were six times more likely to have adopted buprenorphine at the 24-month follow-up interview than CTPs without protocol experience. In addition, buprenorphine adoption was associated with three organizational characteristics. For-profit CTPs were nearly five times more likely than nonprofit CTPs to have adopted buprenorphine at the 24-month follow-up. CTPs with access to physicians were more likely to have adopted buprenorphine than CTPs without access to physicians. Finally, CTPs offering inpatient detoxification were more likely to have adopted buprenorphine than CTPs that do not offer inpatient detoxification.

The second model in Table 2 adds the measure of buprenorphine adoption at baseline to the model. Controlling for adoption at baseline reduces the magnitude of the association between protocol experience and adoption at the 24-month follow-up, but it remains statistically significant. The association between adoption at baseline and at follow-up is indicative of the strong likelihood of sustained use of buprenorphine over time. Two of the organizational characteristics continue to be associated with buprenorphine adoption even after controlling for early adoption, namely, being a for-profit CTP and offering inpatient detoxification. The measure for access to physicians was no longer significantly associated with adoption at follow-up once baseline adoption was controlled in the model. Notably, the bivariate differences in adoption at baseline due to public funding and methadone availability are not significant in either of these models of buprenorphine adoption at follow-up.

4. Discussion

Although there are a growing number of studies about the adoption of buprenorphine, this is the first study to examine the pattern of adoption, discontinuation, and sustainability of this pharmacotherapy over a 2-year period. Previous studies used either a cross-sectional design (Ducharme & Abraham, 2008; Koch et al., 2006) or a time frame of a year or less without controlling for baseline adoption (Ducharme et al., 2007; Knudsen et al., 2006). This examination of buprenorphine adoption over a 2-year period within the CTN revealed accelerating adoption over time. The percentage of CTPs using buprenorphine doubled over this 2-year period. Among CTPs using buprenorphine at the 24-month follow-up, about one third of these CTPs were early adopters, and two thirds were later adopters. This increase in adoption is consistent with Rogers (2003) concept of the S-shaped curve of innovation adoption. This type of pattern was similar to a previous study of naltrexone adoption in private sector programs (Oser & Roman, 2007).

This study points to an ongoing benefit of research involvement in promoting the transfer of buprenorphine into practice. The advantage of involvement in a buprenorphine protocol persisted at the 2-year follow-up, even after controlling for whether CTPs had already adopted buprenorphine as of the baseline interview. This association is consistent with the argument made by Rogers (2003) about the importance of trialability of innovations, in terms of whether organizations can gain experience with an innovation on a limited basis. Clinical trials offer such experience, where an organization does not have to commit to long-term adoption but can

try an innovation for a limited period with a specified number of clients. Consistent with the broader literature on research networks (Fennell & Warnecke, 1988; Laliberte, Fennell, & Papandonatos, 2005), this finding suggests that the value of conducting clinical research in real-world settings extends beyond the substantive findings of clinical trials. In the case of buprenorphine, such research has had a measurable impact on adoption behavior. However, it should also be noted that the selection of CTPs for protocol involvement was not a random process. There was some variability in the criteria used to select CTPs across the different buprenorphine protocols, but CTPs did need to demonstrate the capacity to serve as research sites.

Although protocol involvement offered an advantage in terms of sustainability across the 2-year period, much of the later adoption over the 24-month follow-up period occurred within the CTPs that reported no experience with a CTN buprenorphine protocol. This pattern is consistent with Rogers' (2003) concept of "observability," in which innovations are more likely to be adopted when the results of their use can be seen by others. The use of buprenorphine in several trials has meant that the clinical outcomes associated with its use has been a topic of significant discourse within the CTN, as findings have been presented to its members and disseminated via publications and NIDA's Blending Products (<http://www.nattc.org/aboutUs/blendingInitiative/products2.htm>).

These panel longitudinal data also revealed discontinuation by a small subset of CTPs, which had reported using buprenorphine at the baseline interview. There have been no previous studies of buprenorphine that have measured the phenomenon of discontinuation. On the one hand, the number of "discontinuers" was relatively low in terms of the overall sample. However, these discontinuers represent about one third of the 36 CTPs that had adopted buprenorphine at baseline. About half of the CTPs that discontinued using buprenorphine by the follow-up interview had been in a buprenorphine protocol at baseline. It may be that use reported at baseline represented protocol involvement rather than an organizational decision to use buprenorphine as part of its treatment as usual. The number of discontinuers was too low to estimate statistical models to understand organizational characteristics associated with this pattern, but it does suggest that future research might consider why some treatment programs initially adopt a medication and then discontinue its use.

It is important to note that the CTPs within the CTN are not representative of the American treatment system as a whole (Ducharme et al., 2007; Ducharme Roman, in press; McCarty et al., 2008). However, the organizational characteristics associated with buprenorphine adoption at the 24-month follow-up interview are consistent with prior studies. The greater likelihood of adoption in for-profit programs and those facilities with inpatient detoxification services has been reported in studies using data from the National Survey of Substance Abuse Treatment Services (N-SSATS; Ducharme & Abraham, 2008; Koch et al., 2006) and nationally representative samples of the private and public treatment sectors (Knudsen et al., 2006). The greater adoption by for-profit programs may be reflective of environmental changes related to payment sources for buprenorphine services, such as private insurance coverage and the addition of buprenorphine on some state Medicaid formularies (Ducharme Abraham, 2008). We were unable to examine changes in the funding environment, but this represents an important avenue for future research.

Access to physicians is a necessary condition for the adoption of pharmacotherapies. Nearly three quarters of CTPs had at least one physician employed or on contract, which was an important variable in baseline adoption of buprenorphine. In a supplemental analysis (not shown), we examined the small subset of CTPs that did not have physician resources at the baseline interview to see whether gaining access to physicians by the follow-up interview was associated with buprenorphine adoption. Although we did not have enough cases to estimate

multivariate models, there was a significant bivariate association between gaining access to a physician and buprenorphine adoption at follow-up. Although some of the organizational characteristics are structural and less amenable to change, system-level efforts to improve access to physicians through employment or contracts may promote the transfer of pharmacotherapies into routine practice.

One interesting finding is related to whether programs with methadone services are more likely to adopt buprenorphine. These data from programs affiliated with the CTN indicated that at baseline, the odds of buprenorphine adoption were significantly greater in programs offering methadone. Similar results were reported by Koch et al. (2006) using the 2003 N-SSATS data, which roughly parallel the time frame of our baseline data collection. However, we found that at the 24-month follow-up interview, the availability of methadone was no longer associated with buprenorphine adoption.

Several limitations about this research should be noted. The participating CTPs do not constitute a random sample, so it is unclear the extent to which these findings would generalize to other organizations. However, several of the findings are consistent with other national studies, suggesting that despite differences in CTP's organizational characteristics relative to the national system, the patterns of explanatory relationships show signs of consistency. An additional limitation was the relatively small number of organizational characteristics considered as predictors. In part, there was a need to restrict the number of predictors due to the limited number of occurrences of the dependent variable (Cepeda, Boston, Farrar, Strom, 2003; Peduzzi, Concato, Kemper, Holford, Feinstein, 1996). Additional variables would likely explain portions of the variance in buprenorphine adoption. Another limitation is the reliance on self-report data for all measures. It is possible that administrators may err in their descriptions of their programs, although our reliance on self-reports is similar to the federal N-SSATS methodology. Finally, it should be noted that this research does not address the issue of implementation of buprenorphine, particularly in terms of how routinely it is used by CTPs and whether patient characteristics are associated with receiving this medication. These are important directions for future research.

This research contributes to the growing body of literature about the adoption of buprenorphine in CTPs by considering both adoption and discontinuation over a 2-year period. Data from programs affiliated with the National Drug Abuse Treatment CTN suggest that the availability of buprenorphine expanded over this period, although a small percentage of programs discontinued using this medication. These findings point to the dynamic nature of service delivery within treatment programs and the continued need for longitudinal research on how and why programs change over time.

Acknowledgments

The authors gratefully acknowledge the research support of the NIDA (Grant R01DA14482) and the participation of the CTPs affiliated with the National Drug Abuse Treatment CTN in this research.

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Table 1Bivariate logistic regression models of buprenorphine adoption in the CTN at baseline interview ($n = 231$)

Variable	<i>b</i> (<i>SE</i>)	Unadjusted odds ratio
Publicly funded CTP (vs. privately funded)	−0.770 (0.389)	0.463 *
For-profit CTP (vs. nonprofit)	−1.005 (0.757)	0.366
CTP size (log-transformed FTEs)	0.489 (0.194)	1.631 *
Any physicians employed or on contract (vs. no physicians)	1.611 (0.622)	5.007 *
Offers inpatient detoxification (vs. no detoxification)	0.801 (0.410)	2.241 *
Offers methadone (vs. no methadone)	0.803 (0.367)	2.232 *
Experience in a CTN protocol on buprenorphine (vs. no experience)	2.208 (0.398)	9.100 ***

*
 $p < .05$ (2-tailed test).

**
 $p < .001$ (2-tailed test).

Table 2

Multivariate logistic regression models of buprenorphine adoption in the CTN at 24-month follow-up interview (n = 193)

Variable	Model 1	Model 2
	<i>b</i> (SE)	<i>B</i> (SE)
	Adjusted odds ratio	Adjusted odds ratio
Publicly funded CTP (vs. privately funded)	−0.085 (0.375) 0.919	0.138 (0.397) 1.148
For-profit CTP (vs. nonprofit)	1.614 (0.510) 5.024 **	1.815 (0.530) 6.142 **
CTP size (log-transformed FTEs)	−0.290 (0.229) 0.748	−0.285 (0.230) 0.752
Any physicians employed or on contract (vs. no physicians)	1.016 (0.475) 2.763 *	0.834 (0.488) 2.302
Offers inpatient detoxification (vs. no detoxification)	1.555 (0.491) 4.737 **	1.449 (0.508) 4.257 **
Offers methadone (vs. no methadone)	−0.078 (0.391) 0.925	−0.125 (0.407) 0.882
Experience in a CTN protocol on buprenorphine at follow-up (vs. no experience)	1.806 (0.409) 6.085 ***	1.303 (0.451) 3.681 **
Buprenorphine adoption at baseline (vs. nonadoption)	-	1.449 (0.509) 4.258 **
Constant	−1.685 (0.715) *	−1.780 (0.725) *
McKelvey and Zavoina's R ²	0.272	0.314

* $p < .05$ (2-tailed tests).

** $p < .01$ (2-tailed tests).

*** $p < .001$ (2-tailed tests).