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The Adoption of Alcohol Pharmacotherapies in the Clinical Trials Network: The Influence of Research Network Participation

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Abstract

Organizational participation in clinical research may lead to adoption of the intervention by treatment agencies, but it is not known whether research involvement enhances innovativeness beyond the specific interventions that are tested. The National Institute on Drug Abuse's (NIDA) Clinical Trial Network (CTN) is a platform for considering this research question. To date, the CTN has not conducted research on medications for alcohol use disorders (AUDs), so greater adoption of innovative AUD pharmacotherapies by CTN-affiliated programs would suggest an added value of research network participation. Using longitudinal data from a pooled sample of CTN and non-CTN publicly funded treatment programs, we investigate adoption of tablet naltrexone and acamprosate over a two-year period. CTN-affiliated programs were more likely to have adopted tablet naltrexone and acamprosate at 24-month follow-up, net of the effects of a range of organizational characteristics. Research network participation may thus enhance organizational innovativeness to include interventions beyond the scope of the network.

Keywords

Tablet naltrexone; Acamprosate; Research networks; Adoption of innovations; Clinical Trials Network

1. Introduction

The past decade has seen substantial enhancement of opportunities for the use of pharmacotherapies to treat alcohol use disorders (AUDs), highlighted by the approval of acamprosate in 2004 and injectable naltrexone in 2006 by the FDA. Despite these advances and substantial federal efforts to promote use of these medications, adoption of pharmacotherapies within the US substance abuse treatment system remains low (Carroll, 2003; Ducharme, Knudsen, & Roman, 2006a; Knudsen, Roman, & Oser, in press; Lamb, Greenlick, & McCarty, 1998; Institute of Medicine, 2006;). Rates of AUD pharmacotherapy adoption are particularly low in the publicly funded treatment sector. Nationally representative

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data show that in 2004 only 9.2% of publicly funded programs used tablet naltrexone while 32.1% of privately funded programs prescribed the medication (Ducharme, Knudsen, & Roman, 2006a).

A growing research literature examines the adoption of evidence-based practices (EBPs), including both pharmacological and psychosocial innovations in substance abuse treatment (Ducharme, Knudsen, & Roman, 2006a; Ducharme et al., 2006b; Ducharme et al., 2007; Haug et al., 2008; Henggeler et al., 2008; Kirby et al., 2006; Knudsen, Ducharme, & Roman 2007a; Knudsen et al., (in press); Miller et al., 2006; McGovern et al., 2004; Oser & Roman, 2007; Oser & Roman, 2008; Petry & Simcic, 2002; Sholomskas et al., 2005). This literature identifies several critical barriers to adoption of EBPs, with the most prominent being those centered around the lack of resources essential for EBP adoption and implementation (Ducharme, Knudsen, & Roman, 2006a; Ducharme et al., 2006b; Knudsen et al., 2005; Knudsen, Ducharme & Roman, 2006; Knudsen et al. 2007a; Knudsen, Ducharme, & Roman, 2007b; Roman & Johnson, 2002). Moreover, ideological orientations held by administrators and treatment staff in service delivery settings are barriers to adopting new techniques in substance abuse treatment. Some of these techniques are viewed as radically different from existing practices (Abraham, Ducharme, & Roman, 2009; Knudsen et al., 2005; Thomas et al., 2003).

Most studies on the adoption of alcohol pharmacotherapies in the U.S. treatment system have focused on tablet naltrexone. Research shows that programs with greater resources (i.e., organizational size) are more likely to adopt tablet naltrexone (Fuller et al., 2005), as are programs with more educated administrators (Oser & Roman, 2007). Both program accreditation and government ownership are predictive of tablet naltrexone adoption (Fuller et al., 2005; Heinrich & Hill, 2007; Oser & Roman, 2007; Roman & Johnson, 2002). Programs with a greater ability to assess and effectively use information (i.e., greater absorptive capacity) are more likely to adopt tablet naltrexone, particularly programs with a high degree of staff professionalism (Fuller et al., 2005; Knudsen et al., 2007; Oser & Roman, 2007, 2008; Roman & Johnson, 2002). Finally, organizational culture (i.e., holding twelve step meetings onsite) and percentage of referrals from the legal system are negative predictors of tablet naltrexone adoption (Ducharme, Knudsen, & Roman, 2006a; Oser & Roman, 2007).

Interventions to overcome barriers related to resources and staff attitudes are challenging in a specialty area that is notoriously under-funded (McLellan & Meyers, 2004), since such efforts would require increased funding, including payments for medications, expert re-engineering of service delivery processes and structure, and investment in staff training. Attitudinal change among counseling and other treatment staff requires training about both the intervention itself (Abraham, Ducharme, & Roman, 2009; Knudsen et al., 2005; McCarty et al., 2004; Thomas & Miller, 2007; Thomas et al., 2008) and training to help counselors cognitively manage the uncertainty that comes with change (Varra, Hays, Roget, & Fisher, 2008).

Nearly all of the existing studies of EBP adoption in substance abuse treatment examine intraorganizational characteristics and processes to explain organizational adoption behavior with little attention being paid to how interorganizational relationships may also affect adoption behavior. The accumulated literature on interorganizational relationships demonstrates the importance of interorganizational networks on innovation adoption and diffusion. Interorganizational networks facilitate the adoption of innovations by promoting knowledge sharing, resource exchange, and collaboration among members, as well as providing members with the skills, experience, communication channels, and technical assistance necessary to adopt and implement innovations (Becker, 1970; Coleman, Katz, and Menzel, 1966; Erickson & Jacoby, 2003; Gibbons, 2007; Goes & Park, 1997; Mansfield, 1971; Pittaway, Robertson,

Munir, Denyer, & Neely, 2004; Powell, Koput, & Smith-Doerr, 1996; Rogers, 2003; Westphal, Gulati, & Shortell, 1997).

The research of Rogers (2003) and others (e.g., Powell, Koput, & Smith-Doerr, 1996) emphasizes the importance of communication behavior in the adoption of innovations and identifies the clustering of adopters and innovation in networks. In part, this clustering of adopters within networks may reflect the gains in knowledge that organizations can achieve through networks (Erikson & Jacoby, 2003). Erikson and Jacoby (2003) further argue that participating in a network may foster the skills necessary to transfer knowledge about innovations and to implement innovations. A substantial number of studies conducted in business, health, and industrial organizations have confirmed the important role of interorganizational networks and communication in facilitating the diffusion and adoption of new managerial practices, as well as innovations in production and service technology (Erikson & Jacoby, 2003; Gibbons, 2007; Goes & Park, 1997; Pittaway, Robertson, Munir, Denyer, & Neely, 2004; Westphal, Gulati, & Shortell, 1997). For example, Ahuja (2000) found that interorganizational networks had a positive effect on innovation in the chemicals industry. Similarly, Goes and Park (1997) found that interorganizational links had positive effects on innovation capacity and adoption of hospital services and technology.

A specific type of interorganizational network which may influence organizational adoption behavior is a research network. In other healthcare specialties, involvement in research networks has been shown to promote innovation adoption in participating organizations (Fennell & Warnecke, 1988). For example, a study of facility membership in an NCI-funded cancer research network was linked with patient receipt of treatment consistent with recommended guidelines (Laliberte, Fennell, & Papandonatos, 2005).

In this paper, we investigate membership in an interorganizational research network focused on substance abuse-- the National Institute on Drug Abuse's (NIDA) Clinical Trial Network (CTN). Participation in the CTN research network offers treatment organizations advantages that may promote the adoption of EBPs. First, the CTN may provide treatment programs the chance to "try" innovative technologies in the context of a clinical trial, offering a customized experience for center staff to observe the innovation in action in their home organization. Support for this argument was found by Ducharme et al. (2007) who compared the adoption of buprenorphine in CTN affiliated programs and a nationally representative sample of public sector treatment programs. They found that organizational involvement in the CTN's buprenorphine protocols increased the likelihood of buprenorphine adoption at six-month telephone follow-up interview. There was, however, no difference between CTN programs that had not participated in a buprenorphine protocol and non-CTN public sector programs. These results suggested that early adoption was facilitated by specific involvement in a trial rather than simply by membership in the CTN. However, the brief follow up period may have limited the extent to which adoption could have occurred.

Second, as networks continue to evolve over time, members of the network have greater opportunities for exposure to innovative treatment technologies. Information about innovations flows through both formal and informal communication channels. For example, the CTN includes not only face-to-face conferences and meetings but also includes sub-committees and special interest groups that communicate frequently through e-mail and teleconferencing. Results from the CTN's research activities are also disseminated to treatment programs within the network, as well as the field at large.

Evidence about the importance of network participation for innovation adoption over time was supported by Knudsen et al.'s (2009) study of buprenorphine adoption in CTN-affiliated programs over a two-year period. CTN programs participating in any of the buprenorphine

protocols were significantly more likely to adopt the medication at 24-month follow-up compared to programs that were not in the protocols. However, buprenorphine adoption tripled in CTN programs not involved the buprenorphine protocols, suggesting exposure to the medication through the CTN's research network was a factor in the organizational decision to adopt buprenorphine (Knudsen et al., 2009). A limitation of this study was that CTN programs were not compared to programs in the wider addiction treatment system, so it could not answer the question about whether participation in a research network facilitates adoption of innovative treatment techniques or whether CTN-affiliated programs are simply more likely to have organizational characteristics that are advantageous in promoting medication adoption. These results were suggestive, however, that research networks may be valuable in promoting adoption of EBPs even in programs that are not directly involved in the research protocols.

To investigate whether network participation enhances innovativeness beyond specific interventions that are tested within the network, EBPs that are beyond the scope of the CTN must be considered. Adoption of AUD pharmacotherapies by treatment organizations within the CTN offers a test of this issue, since the medications to treat AUDs have not been the subject of trials within the CTN. Approaching this research question requires consideration of whether enhanced adoption is due to involvement in a research network, if CTN-affiliated programs are more likely to have the necessary resources for medication adoption, or both.

To address this research question, we compare the adoption of tablet naltrexone and acamprostate in a pooled sample of public CTN and non-CTN treatment programs over a two-year period, net of a wide range of organizational characteristics. Inclusion of organizational characteristics allows for a more conservative test of the effects of research network participation on adoption of alcohol pharmacotherapies. We hypothesize that participation in the CTN will be a significant predictor of adoption in multivariate models that include a variety of organizational characteristics.

2. Methods

2.1. Data Collection and Samples

Data for these analyses were drawn from two samples of treatment programs in the US addiction treatment system that are part of the National Treatment Center Study. Data were collected at baseline in 2002–2004 via face-to-face interviews with program administrators. Follow-up interviews were conducted 24-months later. In addition to the face-to-face interviews, 3 brief telephone interviews were completed with program administrators at 6 month intervals following the onsite interviews (i.e., at 6, 12, and 18 months following the onsite interview). The University of Georgia's Institutional Review Board approved the protocols for each of the studies. All participating treatment programs received an honorarium of US\$100 for each face-to-face interview.

The first sample involved a representative sample of publicly funded treatment centers throughout the United States. (A full description of the sampling procedures can be found in Knudsen et al., 2007a.) All eligible programs were open to the public, provided substance abuse treatment at an intensity at least equivalent to structured outpatient programming (Mee-Lee, Gartner, Miller, Schulman, & Wilford, 1996), and received a majority of their annual operating revenues from government grants or contracts, such as block grant funds and criminal justice contracts. Programs exclusively providing methadone maintenance services were ineligible for inclusion in the study, but programs offering methadone, as well as other substance abuse treatment services were eligible. At baseline, 362 program administrators were interviewed, representing 80% of eligible programs. At the 24-month follow-up, 14 programs closed and 21 no longer met the eligibility criteria, leaving a potential pool of 327 eligible programs for follow-up. Of these, interviews were completed with 244 program administrators (74.6%

response rate). Non-respondents included 20 administrators with whom interviews were unable to be scheduled after repeated attempts and 63 who refused to participate in the second interview.

The second sample consisted of 240 individual treatment units affiliated with NIDA's Clinical Trials Network recruited in 2002–2004. At the time of the baseline data collection, the CTN was comprised of 109 unique treatment organizations which operated 262 administrative units or cost centers. Generally speaking, units within a larger organization were defined by service population or modality; for example, an organization might operate three distinct programs: methadone services, adolescent residential services, and adult outpatient services. Each program constituted a unit of analysis for this study which was comparable to the units of analysis in the NTCS sample of publicly funded programs (91.6% response rate).

Since the purpose of the current study was to compare the adoption of medications in publicly funded programs, CTN treatment programs that did not meet the eligibility criteria for the public center study were excluded from this analysis. Applying this eligibility criterion resulted in a sample of 147 publicly funded CTN programs at baseline. Of these, 127 were re-interviewed at the 24-month follow-up (86.4% response rate), 5 programs had closed, 7 programs were no longer affiliated with the CTN, and 8 programs refused to participate.

2.2. Measures

Two dependent variables, measuring adoption or current use of acamprosate or tablet naltrexone, were utilized in these analyses. Referral to an external provider was not sufficient to be considered as an adopting program; adoption was defined by directly prescribing the medication to at least one AUD client. First, adoption of acamprosate was measured in 2006 to allow programs roughly 1.5 years to adopt the medication following FDA approval in mid-2004 (1=use of acamprosate in 2006, 0=no use). Acamprosate was not FDA approved for the treatment of AUDs at baseline, thus it was not measured in the initial interview. For programs that were interviewed at baseline in 2004 and 2005, data for this measure was drawn from telephone follow-up interviews conducted in 2006. Second, we measured the adoption of tablet naltrexone at baseline for the treatment of AUDs (1=use of tablet naltrexone at baseline, 0=no use); this same indicator of current use was measured at the 24-month follow-up (1=use of tablet naltrexone at onsite follow-up, 0=no use of tablet naltrexone at onsite follow-up).

To account for the dynamic nature of innovation adoption and discontinuation over time, we also organized programs into a four-category typology based on tablet naltrexone adoption patterns over the two-year period. Programs were coded into one of the following four adopter categories: (1) *earlier adopters*, or programs that used tablet naltrexone at baseline and continued to use at follow-up; (2) *later adopters*, defined as programs that were non-adopters at baseline, but adopted tablet naltrexone by 24-month follow-up; (3) *non-adopters*, or programs that did not use tablet naltrexone at either time point; and (4) *discontinuers*, defined as programs that used tablet naltrexone at baseline but no longer used at 24-month follow-up.

Given our primary interest in whether participation in the CTN is associated with the adoption of alcohol pharmacotherapies, we included a dichotomous measure of *CTN participation*. Programs affiliated with the CTN were coded '1' on this variable (1=CTN participant, 0=non CTN participant).

Consistent with prior research on medication adoption, a variety of organizational characteristics measured at baseline were included in the analyses. *Organizational size* is measured by the number of full-time equivalent employees. To adjust for skew, we performed a natural log transformation of this variable. Program *accreditation* is a dichotomous variable;

programs accredited by the Joint Commission, or the Commission on Accreditation of Rehabilitation Facilities were coded '1' on this variable. *Administrator's highest degree* is a categorical variable (1=less than bachelor's degree, 2=bachelor's degree, 3= master's degree or higher).

Programs with greater absorptive capacity may be more receptive to adopting innovations (Cohen and Levinthal, 1990; Zahra and George, 2002); absorptive capacity is a multidimensional construct measured by workforce professionalism, environmental scanning, and collection of satisfaction data (Knudsen & Roman, 2004). Workforce professionalism is measured by two variables: percentage of counselors with a master's degree or higher (continuous measure) and *access to physicians* (1=program has a prescribing physician on staff or on contract). The *environmental scanning* scale is comprised of 5 items that ask administrators to rate the extent to which their staff's knowledge about treatment techniques was derived from journals, newsletters or other professional publications, participation in professional development, membership in professional/provider associations, personal contacts or promotional materials from pharmaceutical companies, and conversations with members of other substance abuse treatment organizations. Responses to these items ranged from 0 (no extent) to 5 (a very great extent) and were summed to create a scale ranging from 0 to 25 ($\alpha = .67$). *Collection of satisfaction data* is measured by two dichotomous items that ask whether the program collects information from third party payers and key personnel from referral sources regarding their respective levels of satisfaction. Responses to these dichotomous items were summed to create a scale ranging from 0 to 2.

Program culture, membership in a *provider association*, and *government ownership* are dichotomous variables. *Program culture* denotes whether any 12-step meetings are held at the center (1=yes, 0=no). Programs that reported membership in a provider association were coded a '1' on the *provider association* variable and programs owned by city, county, or state governments were coded '1' on the *government ownership* variable. Finally, we measure the percentage of *referrals from the legal system* as a continuous measure.

2.3. Analysis

A variety of analytic techniques were utilized. First, descriptive statistics were calculated for the baseline organizational characteristics as well as the adoption of acamprosate and tablet naltrexone for AUDs over the study period. Second, mean differences between CTN and non-CTN programs on adoption of the medications and organizational characteristics were measured using chi-square or t-tests, depending on the level of measurement. Third, a series of multivariate logistic models were estimated to predict adoption of acamprosate and tablet naltrexone. We report McKelvey and Zavonia's pseudo- R^2 measure of logistic regression model fit (Long and Freese, 2006; Veall & Zimmermann, 1994). Diagnostic tests revealed no evidence of multicollinearity in these multivariate models. Data were analyzed using Stata 10.0 (Statacorp LP, 2007).

3. Results

3.1. Descriptive Statistics

Table 1 compares the organizational characteristics of publicly funded programs within the CTN to the sample of non-CTN programs. There were four significant differences between the two samples. Greater percentages of CTN programs were accredited ($\chi^2=49.295$, $df=1$, $p<.001$) and government-owned ($\chi^2=14.834$, $df=1$, $p<.001$). CTN programs reported receiving a larger percentage of their referrals from the legal system ($t=2.561$, $p<.01$). On average, a greater percentage of CTN counselors held advanced degrees than counselors in non-CTN public programs ($t=3.349$, $p<.001$)

There were significant differences between CTN and non-CTN programs in use of acamprosate in 2006. CTN programs (20.33%) were more likely to report use of acamprosate than non-CTN programs (6.28%) ($\chi^2 = 16.31$, $df = 1$, $p < .001$). Interestingly, the two samples did not differ significantly in use of naltrexone at baseline. At the 24-month follow-up, CTN programs (20.5%) were significantly more likely than non-CTN programs (8.2%) to use tablet naltrexone for AUDs ($\chi^2 = 11.59$, $df = 1$, $p < .01$). Over the two-year period, the percentage of CTN programs using naltrexone increased by about 6 percentage points to 20.5%. In contrast, the use of tablet naltrexone in the non-CTN sample did not change over the two-year period (8.2%).

To further assess adoption, discontinuation, and sustainability of tablet naltrexone for treating AUDs over time, programs were divided into 4 adopter categories. There were significant differences between CTN programs and non-CTN programs in this typology of adoption ($\chi^2 = 11.373$, $df = 3$, $p < .05$). About 7.9% of CTN programs were earlier adopters of tablet naltrexone, compared with 2.5% of non-CTN programs. Later adoption of naltrexone was higher in programs participating in the CTN (12.6%) than non-CTN programs (5.7%). A greater percentage of public programs (86.1%) than CTN members (73.2%) were non-adopters of tablet naltrexone. Finally, 5.7% of CTN programs and 6.3% of non-CTN programs discontinued use of tablet naltrexone for the treatment of AUDs by the 24-month follow-up.

3.2. Multivariate Analysis of Acamprosate Adoption in 2006

Table 2 shows the results of multivariate logistic regression predicting the adoption of acamprosate in 2006. CTN programs were 3.5 times more likely than non-CTN programs to adopt acamprosate in this multivariate model. In addition to CTN participation, two organizational characteristics were predictive of acamprosate adoption in 2006. Programs with a greater percentage of master's level counselors were more likely to adopt acamprosate ($OR = 1.07$, $p < .05$) and programs with access to a prescribing physician were 3.4 times more likely to adopt acamprosate ($OR = 3.37$, $p < .05$). The McKelvey & Zavonia's pseudo R^2 indicates roughly 26% of the variance in adoption of acamprosate was explained by the independent variables.

3.3. Multivariate Analysis of Naltrexone Adoption

Two multivariate logistic regression models were estimated to identify relevant predictors of tablet naltrexone adoption at baseline and the 24-month follow-up interviews (Table 3). Model 1 estimated the adoption of tablet naltrexone for treating AUDs at baseline. Notably, CTN participation was not significantly associated with tablet naltrexone adoption at the time of the baseline interview. One organizational characteristic was associated with adoption—access to physicians. Programs with access to at least one physician on staff or contract were 5.8 times more likely to adopt tablet naltrexone for the treatment of AUDs than programs without access to a prescribing physician. The McKelvey & Zavonia's pseudo R^2 measure of fit indicated that roughly 29% of the variance in tablet naltrexone adoption is explained by the model.

Model 2 of Table 3 presents the model of the adoption of tablet naltrexone at the 24-month follow-up interview. CTN programs were 3.12 times more likely than non-CTN programs to use tablet naltrexone, net of the organizational characteristics and the use of naltrexone at baseline. In addition, government ownership was significantly associated with tablet naltrexone adoption; government owned programs were almost 5 times more likely to have adopted tablet naltrexone for treating AUDs ($OR = 5.038$, $p < .01$). Consistent with our expectations, programs using tablet naltrexone at baseline were more than 4.5 times as likely to use the medication at 24-month follow-up in this multivariate model ($OR = 4.775$, $p < .01$). The McKelvey & Zavonia's pseudo R^2 measure of fit indicated that approximately 39% of the variance in tablet naltrexone adoption is explained by the model.

4. Discussion

This study examined the influence of research network participation on the adoption of naltrexone and acamprosate to treat AUDs using data from a pooled sample of publicly funded community treatment programs within and outside of NIDA's Clinical Trials Network (CTN). Our focus on alcohol treatment medications offered the opportunity to consider whether research network involvement had an impact on openness to innovations outside the scope of the clinical trials conducted within the network. Interestingly, programs within the CTN were not more likely to use tablet naltrexone for AUD treatment at baseline, suggesting that network involvement initially did not foster adoption of use of this medication. However, the baseline data were collected from 2002–2004, within the first few years of the establishment of the network in 1999. The first clinical trial did not begin until 2001, so relatively few CTN programs were directly involved in the CTN's protocols and findings from CTN research had yet to be disseminated. In a sense, the network itself was at a relatively early stage of development at the time of the baseline interview.

While not a significant predictor of naltrexone adoption at baseline, CTN participation was associated with adoption of tablet naltrexone at the 24 month follow-up and adoption of acamprosate in 2006. These differences by CTN participation were significant even in models that included a wide range of organizational characteristics. These findings support the idea that exposure to the process of implementing innovative treatment technologies over time may influence concurrent and future decisions to adopt EBPs. As a result of participation in the research network over time, CTN programs have had significant exposure to and experience with the processes associated with implementing evidence-based practices at the organizational and staff level. Assuming that these findings reflect trends that will continue, the data also suggest that the benefits of research network involvement extend beyond the treatment techniques directly tested in protocols. By cultivating a treatment environment that is receptive to the adoption of alcohol pharmacotherapies, the data suggests that research network participation may lead to a distinctive quality improvement in treatment practices and a wider range of treatment options for clients with AUDs.

This study is also the first to examine adoption, sustainability, and discontinuation of tablet naltrexone for treating AUDs over a two-year period. A greater percentage of CTN programs adopted and sustained use of tablet naltrexone over time with fewer CTN programs discontinuing use. This finding suggests that network participation may offer advantages in terms of both adoption and sustainability. Given the low rates of adoption and sustainability in the publicly funded treatment sector, continued attention to the barriers to adoption in this sector of the treatment system is warranted.

Further, the results highlight the continued importance of access to physicians to promote the use of alcohol pharmacotherapies, although such access is no guarantee of adoption. The majority of both CTN and non-CTN programs had access to at least one physician, either directly through employment or via contracts. In fact, there was not a significant difference in access to physicians between the CTN and non-CTN programs. However, only a minority of programs had adopted AUD pharmacotherapies. While lack of access to prescribing staff remains a barrier to adoption for some programs, a majority (67.5%) of CTN programs and over three-fourths of non-CTN programs (82.2%) with access to a physician did not prescribe either of the medications to AUD clients. These data suggest that training and dissemination efforts targeted specifically at physicians about these medications are warranted. Continued research on barriers to adoption is needed, particularly to better understand why some physicians involved in substance use disorder (SUD) treatment do not prescribe AUD pharmacotherapies.

Finally, these results shed light on what may be a powerful and efficient tool to encourage the adoption of EBPs in substance abuse treatment. While NIDA's CTN required a large monetary investment to support a research agenda that now includes more than 25 multi-site clinical trials, the concept of building interorganizational networks of treatment programs that allow for information-sharing may be a less costly intervention that can still yield benefits in terms of innovation adoption. National, state, and local associations of substance abuse treatment providers have proliferated over the past decade, but have not yet developed a distinctive template for routine interactions between treatment organizations. Future research should consider whether these types of networks that are based on shared interests rather than research involvement can also facilitate greater innovation adoption. The involvement of researchers in such organizations appears a promising possibility for encouraging some of the interorganizational interactions and exposures to EBPs that have occurred within the CTN. Considering treatment organizations in a group context for a variety of interactions and exposures to EBPs appears potentially much more efficient and less costly than attempting to add resources, re-engineer processes, or introduce in-depth training on a center-by-center basis.

There are several limitations of the current study. First, this study includes only programs in the publicly funded addiction treatment sector, so it is not representative of the entire treatment system. Second, this study focuses on the adoption of alcohol pharmacotherapies and does not address implementation. Adoption of a pharmacotherapy refers to any use of the medication; therefore, a program would be considered an adopter regardless of how many clients actually receive the medication. Implementation, or the routine use of pharmacotherapy in a treatment program, calls for measuring the percentage of eligible clients receiving a pharmacotherapy. Implementation is indeed the true measure of organizational change represented by EBP use, but in this instance more time needs to pass for meaningful implementation analyses.

Third, although every effort was made to include relevant predictors of medication adoption, other variables not included in the models may influence the adoption of tablet naltrexone and acamprostate. We drew upon the existing literature on medication adoption in order to identify a reasonable range of organizational characteristics but realize that our list is likely incomplete. In addition, programs that are affiliated with the CTN are not randomly selected, but rather are part of competitive grant applications that support a given research node. For many of the organizational variables, there were no significant differences between the two types of programs, most notably for access to physicians. Nonetheless, there may be unmeasured characteristics of CTN programs that offer them additional advantages in terms of innovation adoption that should be explored in future studies.

Finally, timing precluded measuring the adoption of injectable naltrexone for treating AUDs since it did not receive FDA approval until April 2006. Future research will address this limitation to determine whether the adoption of injectable naltrexone is similar to that of tablet naltrexone. Furthermore, we will continue to monitor the adoption of all of these medications over time, with the goal of identifying persistent barriers to the adoption and implementation of alcohol pharmacotherapies in the US addiction treatment system.

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References

- Abraham AJ, Ducharme LJ, Roman PM. Counselor attitudes toward pharmacotherapy for alcohol dependence. *Journal of Studies on Alcohol and Drugs* 2009;70:628–635. [PubMed: 19515305]
- Ahuja G. Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly* 2000;45:425–455.
- Becker MH. Sociometric location and innovativeness: Reformulation and extension of the diffusion model. *American Sociological Review* 1970;35:262–282.
- Carroll KM, Rounsaville BJ. Bridging the gap: A hybrid model to link efficacy and effectiveness research in substance abuse treatment. *Psychiatric Services* 2003;54:333–339. [PubMed: 12610240]
- Cohen WM, Levinthal DA. Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly* 1990;35:128–152.
- Coleman, JS.; Katz, SE.; Menzel, H. Medical innovation. New York: Bobbs-Merrill; 1966.
- Ducharme LJ, Knudsen HK, Roman PM. Trends in the adoption of medications for alcohol dependence. *Journal of Clinical Psychopharmacology* 2006a;26:S13–S19. [PubMed: 17114950]
- Ducharme LJ, Knudsen HK, Roman PM. Evidence-based treatment for opiate-dependent patients: Availability, variation, and organizational correlates. *American Journal of Drug and Alcohol Abuse* 2006b;32:569–575. [PubMed: 17127545]
- Ducharme LJ, Knudsen HK, Roman PM, Johnson JA. Innovation adoption in substance abuse treatment: Exposure, trialability, and the Clinical Trials Network. *Journal of Substance Abuse Treatment* 2007;32:321–329. [PubMed: 17481455]
- Erickson CL, Jacoby SM. The effect of employer networks on workplace innovation and training. *Industrial and Labor Relations Review* 2003;56:203–223.
- Fennell, ML.; Warnecke, RB. The diffusion of medical innovations. New York: Plenum; 1988.
- Fuller BE, Rieckmann T, McCarty D, Smith KW, Levine H. Adoption of naltrexone to treat alcohol dependence. *Journal of Substance Abuse Treatment* 2005;28:273–280. [PubMed: 15857728]
- Gibbons DE. Interorganizational network structure and diffusion of information through a health care system. *American Journal of Public Health* 2007;97:1684–1692. [PubMed: 17329666]
- Goes JB, Park SH. Interorganizational links and innovation: The case of hospital services. *Academy of Management* 1997;40:673–696.
- Haug NA, Shopshire M, Tajima B, Gruber V, Guydish J. Adoption of evidence-based practices among substance abuse treatment providers. *Journal of Drug Education* 2008;38:181–192. [PubMed: 18724657]
- Heinrich CJ, Hill CJ. Role of state policies in the adoption of naltrexone for substance abuse treatment. *Health Services Research* 2008;43:951–970. [PubMed: 18454775]
- Henggler SW, Chapman JE, Rowland MD, Halliday-Boykins CA, Randall J, Shackelford J, Schoenwald SK. Statewide adoption and initial implementation of contingency management for substance-abusing adolescents. *Journal of Consulting and Clinical Psychology* 2008;76:556–567. [PubMed: 18665685]
- Institute of Medicine. Improving the quality of health care for mental and substance-use disorders: Quality chasm series. Washington, DC: National Academy Press; 2006.
- Kirby KC, Benishek LA, Dugosh KL, Kerwin ME. Substance abuse treatment providers' beliefs and objections regarding contingency management: Implications for dissemination. *Drug and Alcohol Dependence* 2006;85:19–27. [PubMed: 16650657]
- Knudsen HK, Abraham AJ, Johnson JA, Roman PM. Buprenorphine adoption in the National Drug Abuse Treatment Clinical Trials Network. *Journal of Substance Abuse Treatment* 2009;37:307–312. [PubMed: 19577406]
- Knudsen HK, Ducharme LJ, Roman PM. Early buprenorphine adoption in substance abuse treatment centers: Data from the private and public sectors. *Journal of Substance Abuse Treatment* 2006;30:363–373. [PubMed: 16716852]
- Knudsen HK, Ducharme LJ, Roman PM. The adoption of medications in substance abuse treatment: Associations with organizational characteristics and technology clusters. *Drug and Alcohol Dependence* 2007a;87:164–174. [PubMed: 16971059]

- Knudsen HK, Ducharme LJ, Roman PM. Racial and ethnic disparities in SSRI availability in substance abuse treatment. *Psychiatric Services* 2007b;58:55–62. [PubMed: 17215413]
- Knudsen HK, Ducharme LJ, Roman PM, Link T. Buprenorphine diffusion: The attitudes of substance abuse treatment counselors. *Journal of Substance Abuse Treatment* 2005;29:95–106. [PubMed: 16135338]
- Knudsen HK, Roman PM. Modeling the use of innovations in private treatment organizations: The role of absorptive capacity. *Journal of Substance Abuse Treatment* 2004;26:353–361. [PubMed: 14698799]
- Knudsen HK, Roman PM, Oser CB. Facilitating factors and barriers to the use of medications in publicly funded addiction treatment organizations. *Journal of Addiction Medicine*. in press.
- Laliberte L, Fennell ML, Papandonatos G. The relationship of membership in research networks to compliance with treatment guidelines for early-stage breast cancer. *Medical Care* 2005;43:471–479. [PubMed: 15838412]
- Lamb, S.; Greenlick, MR.; McCarty, DE. Bridging the gap between practice and research: Forging partnerships with community-based drug and alcohol treatment. Washington, D.C: National Academy Press; 1998.
- Long, JS.; Freese, J. Regression models for categorical dependent variables using Stata. 2. College Station: Stata Corporation; 2006.
- Mansfield, E. Technological Change. New York: W.W. Norton; 1971.
- Mee-Lee, DL.; Gartner, L.; Miller, MM.; Shulman, GD.; Wilford, BB. Patient placement criteria for the treatment of substance-related disorders. 2. Chevy Chase, MD: ASAM; 1996.
- Miller WR, Sorensen JL, Selzer JA, Brigham GS. Disseminating evidence-based practices in substance abuse treatment: A review with suggestions. *Journal of Substance Abuse Treatment* 2006;31:25–39. [PubMed: 16814008]
- McCarty D, Reickmann T, Green C, Gallon S, Knudsen J. Training rural practitioners to use buprenorphine: Using The Change Book to facilitate technology transfer. *Journal of Substance Abuse Treatment* 2004;26:203–208. [PubMed: 15063914]
- McGovern M, Fox T, Xie H, Drake RE. A survey of clinical practices and readiness to adopt evidence-based practices: Dissemination research in an addiction treatment system. *Journal of Substance Abuse Treatment* 2004;26:305–312. [PubMed: 15182895]
- McLellan AT, Meyers K. Contemporary addiction treatment: A review of systems problems for adults and adolescents. *Biological Psychiatry* 2004;56:764–770. [PubMed: 15556121]
- Oser CB, Roman PM. Organizational-level correlates of adoption over time: Naltrexone in private substance use-disorders treatment centers. *Journal of Studies on Alcohol and Drugs* 2007;68:852–861. [PubMed: 17960303]
- Oser CB, Roman PM. A categorical typology of naltrexone-adopting private substance abuse treatment centers. *Journal of Substance Abuse Treatment* 2008;34:433–442. [PubMed: 17997266]
- Petry NM, Simcic F Jr. Recent advances in the dissemination of contingency management techniques: clinical and research perspectives. *Journal of Substance Abuse Treatment* 2002;23:81–86. [PubMed: 12220605]
- Pittaway L, Robertson M, Munir K, Denyer D, Neely A. Networking and innovation: A systematic review of the evidence. *International Journal of Management Reviews* 2004;5/6:137–168.
- Powell WW, Koput KW, Smith-Doerr L. Interorganizational collaboration and the locus of innovation: Networks of learning in technology. *Administrative Science Quarterly* 1996;41:116–145.
- Rogers, EM. Diffusion of innovations. 5. New York: Free Press; 2003.
- Roman PM, Johnson JA. Adoption and implementation of new technologies in substance abuse treatment. *Journal of Substance Abuse Treatment* 2002;22:211–218. [PubMed: 12072165]
- Sholomskas DE, Syracuse-Siewert G, Rounsaville B, Ball SA, Nuro KF, Carroll KM. We don't train in vain: A dissemination trial of three strategies of training clinicians in cognitive-behavioral therapy. *Journal of Consulting and Clinical Psychology* 2005;73:106–115. [PubMed: 15709837]
- Stata Statistical Software: Version 10. College Station(TX): StataCorp LP; 2007.
- Thomas CP, Wallack SS, Lee S, McCarty D, Swift R. Research to practice: adoption of naltrexone in alcoholism treatment. *Journal of Substance Abuse Treatment* 2003;24:1–11. [PubMed: 12646325]

- Thomas S, Miller PM. Knowledge of attitudes about pharmacotherapy for alcoholism: A survey of counselors and administrators in community-based addiction treatment centers. *Alcohol* 2007;42:113–118.
- Thomas S, Miller PM, Randall PK, Book SW. Improving acceptance of naltrexone in community addiction treatment centers: a pilot study. *Journal of Substance Abuse Treatment* 2008;35:260–268. [PubMed: 18329227]
- Varra AA, Hayes SC, Roget N, Fisher G. A randomized controlled trial examining the effect of acceptance and commitment training on clinician willingness to use evidence-based pharmacotherapy. *Journal of Consulting and Clinical Psychology* 2008;76:449–458. [PubMed: 18540738]
- Veall MR, Zimmermann KF. Evaluating Pseudo- R^2 for binary probit models. *Quality & Quantity* 1994;28:151–164.
- Westphal JD, Gulati R, Shortell SM. Customization or conformity? An institutional and network perspective on the content and consequences of TQM adoption. *Administrative Science Quarterly* 1997;42:366–394.
- Zahra SA, George G. Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review* 2002;27:185–203.

Table 1

Descriptive Statistics

Variables	Total sample (N=371)	Public programs (N=244)	CTN programs (N=127)
FTEs (log transformed), M (SD)	2.95 (.982)	2.91 (1.009)	3.02 (.926)
Administrator degree	2.52 (.723)	2.48 (.735)	2.60 (.696)
Accredited, % **	39.5	26.7	63.8
Environmental scanning	14.74 (4.24)	14.64 (4.34)	14.94 (4.05)
Collection of satisfaction data	1.28 (.584)	1.24 (.589)	1.37 (.56)
Twelve step meetings held onsite	.616 (.487)	.627 (.485)	.595 (.493)
Provider association	.567 (.496)	.552 (.498)	.598 (.492)
Referrals from legal system, % *	37.2 (28.47)	39.96 (28.67)	31.95 (27.43)
Master's degree, % **	37.42 (32.40)	33.4 (30.53)	45.31 (34.57)
Prescribing physician, %	63.3	62.3	65.4
Government owned, % **	19.1	24.8	7.9
CTN program, %	34.1	0.0	100.0
Acamprosate adoption in 2006, %	11.1	6.3	20.3
Tablet naltrexone adoption at baseline, %	10.2	8.2	14.2
Tablet naltrexone adoption at 24-month follow-up, %	12.4	8.2	20.5

* $p < .05$

** $p < .01$ (two-tailed tests), denotes mean differences between CTN and non-CTN programs based on chi-square or t-tests, depending on the level of measurement of the variable.

Table 2

Multivariate logistic regression models predicting the adoption of acamprosate in 2006

Variable	b (SE)	Odds ratio
CTN participation	1.26 (.472)	3.53**
FTEs (log transformed)	-.004 (.241)	.996
Administrator degree	-.174 (.318)	.8399
Accredited	.035 (.480)	1.036
Environmental scanning	.077 (.050)	1.075
Collection of satisfaction data	-.030 (.269)	.971
Twelve step meetings held onsite	.243 (.435)	1.275
Provider association	.189 (.424)	1.207
Referrals from legal system, %	-.0001 (.008)	.999
% Master's level counselors	.014 (.007)	1.014*
Prescribing physician	1.215 (.610)	3.368*
Government owned	.141 (.584)	1.15
McKelvey & Zavonia's R ²	.267	

*
 $p < .05$ **
 $p < .01$ (two-tailed tests).

Table 3

Multivariate logistic regression models predicting the adoption of tablet naltrexone at baseline and 24-month follow-up

Variable	Model 1 Adoption at Baseline		Model 2 Adoption at 24-month Follow-up	
	b(SE)	Odds ratio	b(SE)	Odds ratio
CTN participation	.59 (.451)	1.809	1.156 (.453)	3.178**
FTEs (log transformed)	-.087 (.227)	.917	-.015 (.225)	.985
Administrator degree	-.399 (.289)	.671	.331 (.349)	1.392
Accredited	.186 (.452)	1.205	.809 (.446)	2.246
Environmental scanning	.087 (.049)	1.091	.063 (.047)	1.065
Collection of satisfaction data	.276 (.264)	1.317	.081 (.259)	1.084
Twelve step meetings held onsite	.629 (.446)	1.875	.245 (.422)	1.278
Provider association	.303 (.412)	1.354	.088 (.409)	1.092
Referrals from legal system, %	-.007 (.008)	.993	.0001 (.007)	1.000
% Masters level counselors	.005 (.007)	1.005	.006 (.007)	1.005
Prescribing physician	1.764 (.667)	5.837**	1.106 (.606)	3.023
Government owned	.411 (.513)	1.51	1.617 (.502)	5.038**
Baseline adoption	--		1.563 (.468)	4.775**
McKelvey & Zavonia's R ²	.291		.395	

*
 $p < .05$

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