



Predictors of retention in methadone programs: A signal detection analysis

Steven W. Villafranca*, John D. McKellar, Jodie A. Trafton, Keith Humphreys

Center for Health Care Evaluation, Veterans Affairs Palo Alto Health Care System & Stanford University School of Medicine, CA, USA

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Abstract

Retention in Opioid Agonist Therapy (OAT) is associated with reductions in substance use, HIV risk behavior, and criminal activities in opioid dependent patients. To improve the effectiveness of treatment for opioid dependence, it is important to identify predisposing characteristics and provider-related variables that predict retention in OAT. Participants include 258 veterans enrolled in 8 outpatient methadone/L-alpha-acetylmethadol (LAAM) treatment programs. Signal detection analysis was utilized to identify variables predictive of 1-year retention and to identify the optimal cut-offs for significant predictors. Provider-related variables play a vital role in predicting retention in OAT programs, as higher methadone dose (≥ 59 mg/day) and greater treatment satisfaction were among the strongest predictors of retention at 1-year follow-up.

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1. Introduction

Opioid Agonist Therapy (OAT) is an evidence-based treatment for opioid dependence [Department of Veterans Affairs/Department of Defense (VA/DoD, 2001); Practice Guideline for the Treatment of Patients with Substance Use Disorders: Alcohol, Cocaine, Opioids (PGTPSUD, 1995)]. OAT has been shown to reduce heroin and other opioid use by preventing withdrawal, reducing craving, and blocking the “high” associated with use of illicit opioids (Faggiano et al., 2003; VA/DoD, 2001). In addition, OAT has significant public health benefits including reductions in criminal activity, HIV-risk behaviors, and the negative medical, legal, and social consequences of substance use (Ball et al., 1988; Metzger et al., 1993).

Although OAT consistently produces long-term reductions in opioid use (Newman and Whitehall, 1979; Marsch, 1998; Strain et al., 1999; Johnson et al., 2000), patient dropout is a problem (Hubbard et al., 1989; Simpson, 1981; De Leon, 1991; Marlatt et al., 1997; Simpson et al., 1997; Rabinowitz and Marjefsky, 1998; Mertens and Weisner, 2000). Retention is a critical issue because discharge from OAT programs is followed by relapse and other adverse outcomes in the majority of opioid dependent patients (Gerstein et al., 1994). Treatment dropout can lead to overdose, HIV and Hepatitis C infection or transmission, dan-

gerous criminal behavior, and premature mortality (Davoli et al., 1993; Caplehorn et al., 1996; Zaric et al., 2000).

The behavioral model of health care utilization (Aday and Anderson, 1974; Aday et al., 1999; Anderson, 1995; Anderson and Newman, 1973) provides a framework for examining factors associated with patient utilization of health care services. Most studies utilizing this model focus on variables falling into three patient-centered categories: predisposing, enabling, and need.

Predisposing characteristics occur before illness onset and include demographic characteristics such as age, ethnic background, and employment status. Older age, which has been posited to be related to increasing dissatisfaction with addict lifestyle and health concerns, has been associated with retention in methadone programs in several studies (Mertens and Weisner, 2000; Saxon et al., 1996; Stark, 1992).

Enabling characteristics traditionally refer to “means” factors such as insurance coverage or income, but have more recently been extended to include social support (Beckman and Kocel, 1982). Enabling characteristics, such as marital status, have also been found to predict retention rates (Babst et al., 1971).

Need characteristics stem from the severity of the illness. Low composite scores on the Addiction Severity Index (ASI), such as legal problems (Babst et al., 1971; Saxon et al., 1996) and psychiatric problems (McLellan, 1983), are common examples of need characteristics predictive of retention.

A recent study by authors of this model (Phillips et al., 1998) notes, however, that provider-related variables have been largely neglected. Phillips et al. (1998) define provider-related variables

* Corresponding author. Tel.: +1 650 493 5000x27131; fax: +1 650 617 2736.
E-mail address: Steven.Villafranca@va.gov (S.W. Villafranca).

as patient characteristics that interact with provider characteristics to influence utilization (e.g. retention). Our review of the literature revealed that the only provider-related variables included in previous OAT retention studies were methadone dosage levels (Torrens et al., 1996; Del Rio et al., 1997; Caplehorn et al., 1998; D'Ippoliti et al., 1998; Caplehorn and Bell, 1991; PGTPSUD, 1995; Joe et al., 1991; Preston et al., 2000; Strain et al., 1999), frequency of methadone dosing (Rhoades et al., 1998), the effects of psychosocial services (McLellan et al., 1993), and the degree to which providers have an abstinence orientation (Caplehorn et al., 1998; D'Ippoliti et al., 1998). An important missing piece to the retention puzzle is data on the patient's perception of treatment. Such data acknowledges that retention is not a static process driven purely by the patient, but instead is a dynamic process that reflects the interaction between the patient and the treatment environment. In the current study, we include patient's satisfaction with treatment as a predictor of retention.

Determining a methadone dose that is sufficient to suppress opioid withdrawal and craving has been identified as a *critical* variable in regards to retention, however, methadone dosage level does not fit into the traditional behavioral health care utilization model. In the current study, methadone dose is considered to be a provider-related variable. Over the last three decades, studies have consistently demonstrated, and clinical practice guidelines (CPGs) have reflected, that methadone doses of 60 mg/day (i.e. high dose) or greater are associated with better retention and outcome (Caplehorn and Bell, 1991; PGTPSUD, 1995; Joe et al., 1991; Preston et al., 2000; Strain et al., 1999). For example, D'Ippoliti et al. (1998) examined 1503 patients in public treatment centers and found that patients taking ≥ 60 mg/day were 70% more likely to remain in treatment than patients receiving < 30 mg/day. Another study of methadone maintenance patients demonstrated that dropouts were less frequent at methadone doses of ≥ 65 mg/day compared to those receiving doses of 45–60 mg/day (Del Rio et al., 1997). A study that examined 370 opioid-dependent patients, found that the retention rates in a methadone program after 2 years of treatment were 72% for patients receiving > 80 mg/day (Torrens et al., 1996). As an added benefit, high doses of methadone have been shown to predict reduced cocaine use in polysubstance users (Saxon et al., 1996). In the current study we also include methadone dose as a predictor of retention.

The current study builds upon the OAT retention literature by addressing the following questions. First, how well do previously studied predisposing, need, and enabling characteristics predict retention when provider-related variables such as patient satisfaction with treatment and dosage level are added into the model? Second, how well do these variables independently predict outcome?

2. Methods

2.1. Participants

The patient sample consisted of 267 veterans enrolled in methadone/LAAM treatment programs between November

2000 and October 2002. Patients were participants in the Multi-site Opiate Substitution Treatment (MOST) study; an observational study which examined clinical practices and outcomes in OAT in eight participating VA OAT treatment facilities (Humphreys et al., 2003). Participants were recruited as they enrolled for OAT at one of the eight treatment facilities.

Clinics in the MOST study were chosen based upon estimates of their adherence to clinical practice guideline recommendations for opioid substitution treatment; four clinics were chosen because they more consistently provided patients with methadone doses above the guideline recommended 60 mg/day minimum methadone dose and had more counseling staff available per patient to provide psychosocial services. The other four clinics less consistently dosed patients over 60 mg/day and had fewer counseling staff available. Retention information was not available for 3% of the sample, which resulted in a final sample of 258 participants.

2.2. Measures and variables

2.2.1. Demographics. Continuous variables included age and length of marriage, whereas categorical variables included religious background, gender, and satisfaction with marriage.

2.2.2. Diagnostic data and symptom measures. All diagnoses were assessed using the International Classification of Diseases—9th Revision (ICD-9-CM; Health Care Financing Administration, 1991). Chronic pain, HIV, Hepatitis C, Post-Traumatic Stress Disorder, schizophrenia, bipolar disorder, and depression diagnoses were made by physicians over the course of the study and were derived from participants' charts.

2.2.3. Methadone mean dose. Dosing records obtained from each clinic provided daily dosing information, including drug and dosage received, for each day of the year following treatment entry for each patient. In cases where patients were treated with LAAM, LAAM dosages were converted to methadone equivalents. Methadone equivalents were calculated as the LAAM dose divided by 1.69 for 72-h LAAM dosing schedules, or LAAM dose divided by 1.25 for 48 h dosing schedules. From these data, mean dosage over the first year of treatment, maximum dose for the year, number of days in treatment (i.e. the number of days from treatment entry to the last dose received in their first year of treatment), and whether or not the patient dropped out of treatment were obtained.

2.2.4. Addiction Severity Index (ASI). The ASI is a semi-structured interview that measures medical, employment, drug, alcohol, social, legal, and psychological problem severity in the last month and over the patients lifetime (McLellan et al., 1992). Patients' self-report of the frequency, intensity, and duration of specific problems are used to derive individual composite severity scores in each category. Composite scores range from zero to one, with higher scores indicating increased severity. Composite scores include: medical, employment, alcohol, drug, legal, family, social, and psychological. The legal category was further subdivided into the number of violent (i.e. murder, rape,

robbery, and assault) and nonviolent (i.e. shoplifting, burglary, parole violations, drug charges, forgery, weapons offenses, and prostitution) arrests.

2.2.5. SF-36V. The SF-36V is a version of the SF-36 Quality of Life Index that has been validated for use in veteran populations (Kazis et al., 1999). It assesses quality of life, including problems with health, physical and emotional functioning, mood, pain and social functioning. Composite scores include: physical functioning, general health, vitality, mental health, social functioning, and bodily pain.

2.2.6. High Risk Injection Practices Questionnaire. The High Risk Injection Practices Questionnaire consists of 15 items, and measures specific injection practices of intravenous drug users (NOVA Research Company, 1989).

2.2.7. Client Satisfaction Questionnaire (CSQ-8). The CSQ-8 is an eight-item self-report measure that assesses treatment satisfaction (Larsen et al., 1979). Sample items include: “How satisfied are you with the amount of help you have received?” and “Have the services you received helped you deal more effectively with your problems?” Each item is scored from 1 to 4, resulting in a maximum score of 32.

2.3. Data analysis

Signal detection, or Receiver Operating Characteristics (ROC) analysis, is better suited than logistic regression for identifying provider-related and patient-centered variables predictive of methadone program retention. ROC was selected in the present study because it provides several advantages over more traditional analytic strategies such as logistic regression. Logistic regression is useful for identifying individuals with a homogenous outcome, but heterogeneous in risk prediction (Kiernan et al., 2001). Specifically, ROC is better suited for identifying individuals that are homogenous in risk prediction *and* outcome (Kiernan et al., 2001); where the outcome is retention, coded as the patient remaining in OAT >364 days or not, and the risk predictors consist of provider-related and patient-related variables. Type II error is a concern when utilizing a form of exploratory analysis such as ROC, regardless of the amount of variables used in the analysis. However, because the ROC analysis is used solely as a first step in hypothesis generation and model development, the benefits appear to outweigh the risks of Type II error. Multicollinearity is a methodological concern when examining homogenous risk predictors, however, there is little effect on the results for ROC (Kraemer, 1992). Due to the large amount of variables, as well as several potentially homogenous predictors utilized in the present study, ROC was selected as an ideal methodology. Although stepwise logistic regression can also handle highly collinear predictors, the order of predictor entry can affect the results (McGee et al., 1984), which also makes ROC better suited to compare large numbers of variables. Significant higher order interactions are difficult to predict with logical regression due to a potential lack of statistical power (Cohen, 1988), whereas, ROC inherently has the

ability to detect higher order interactions due to its methodological underpinnings (Kiernan et al., 2001). In addition, the ability of ROC to systematically examine higher order interactions reduces the bias that may be involved in investigator identified predictors and interaction terms (Kiernan et al., 2001). When an exploratory methodology is implemented, investigator identified interaction terms may result in incorrect subgroup identification (Kiernan et al., 2001). Previous research on treatment retention has focused almost exclusively on the main effect of patient-related and provider-related predictors, and the ability to systematically examine interactions between these factors using ROC analysis allows for the potential development of more complicated and multifaceted models of treatment retention.

ROC has traditionally been used in the medical field to identify characteristics of subgroups at risk for disease or poor health outcomes; ROC has been used to identify predictors of outcome in studies of dieting, physical activity, and smoking cessation (Kiernan et al., 1998; Killen et al., 1992; King et al., 1997; Smith et al., 1999; Winkleby et al., 1994). ROC determines cut points at which outcome predictions differ. This provides information with direct clinical utility for identifying at risk patients (King et al., 1997). The current study proposes to identify both provider-related and patient-centered variables responsible for OAT program retention using ROC and to determine the ideal cut-points for those variables that are significant. A total of 69 independent variables were used in the analysis.

3. Results

3.1. Participants

Mean age for participants was 48.39 ± 9.40 , 98% of whom were male. The sample was racially diverse, comprising 51% African American, 32% Caucasian, and 11% Hispanic. Fourteen percent of the population had recently been in a controlled environment (i.e. jail or an inpatient program). Thirty days prior to entering treatment, 86% used heroin, 49% used cocaine, 21% used cannabis, 17% used alcohol, 16% used illicitly obtained opioid medications, and 10% used illicitly obtained sedatives. Only 1% of patients used barbiturates (see Table 1 for participant characteristics).

3.2. ROC analysis

The following ROC analysis (the software is available free of charge at <http://mirecc.stanford.edu>) identifies both patient-centered and provider-related variables important in determining retention rates among subgroups of patients. The resulting product is the formation of a hierarchical decision tree that defines distinct groups (Fig. 1). Six groups were identified and are ranked from high to low on rates of retention. The overall retention rate for the entire sample was 57% ($N=147$). Mean dose discriminated retained versus non-retained patients at 1-year follow-up with a cut-off score of 59 mg/day [$\chi^2 (1, N=258) = 36.04, p < .001; k = .36$]. Patients with a mean dose of 59 mg/day or higher at 1-year follow-up had a 70% ($n = 120/171$)

Table 1
Demographic frequencies

Variable	Percent of sample (N = 258) (%)
Gender	
Male	98
Female	2
Age	
18–40	11
41–54	70
55 and above	19
Ethnicity	
Caucasian	32
African American	51
Hispanic	11
Other	6
Controlled environment (past 30 days)	
No	86
Yes (i.e. jail or inpatient treatment)	14
Substance use (past 30 days)	
Heroin	86
Cocaine	49
Cannabis	21
Alcohol	17
Opioid medications (illicitly obtained)	16
Sedatives (illicitly obtained)	10
Barbiturates	1

retention rate compared to 31% ($n = 27/87$) of patients with a mean dose of less than 59 mg/day.

3.3. Patients with a mean dose of 59 mg/day or higher

For the subgroup of patients with mean doses of 59 mg/day or higher, the signal detection analysis further divided these patients based on their level of treatment satisfaction [χ^2 (1, $n = 171$) = 12.73, $p < .001$; $k = .27$]. For patients with a mean dose of 59 mg/day or higher and high treatment satisfaction (≥ 21), 81% ($n = 100/124$) were retained at 1-year compared to 41%

($n = 7/17$) of patients with treatment satisfaction less than 21 (group 5). Group 5 marks the end of testing at this branch for the subgroup of patients receiving mean doses of 59 mg/day or higher with treatment satisfaction less than 21 because the analysis could provide no further discrimination.

Patients with a mean dose of 59 mg/day or higher and high treatment satisfaction were further divided based on the number of nonviolent arrests [χ^2 (1, $n = 124$) = 12.50, $p < .001$; $k = .31$]. Fifty percent ($n = 9/18$) of patients with 17 nonviolent arrests or higher were retained at 1-year follow-up (group 4). Patients with a lower number of nonviolent arrests (< 17) had a 86% ($n = 90/105$) retention rate (group 1). Groups 1 and 4 mark the end of testing for both branches in the tree because the remaining variables could not provide any further discrimination.

3.4. Patients with a mean dose of less than 59 mg/day

For the subgroup of patients with mean doses of less than 59 mg/day, the signal detection analysis further divided these patients based on their age [χ^2 (1, $n = 87$) = 10.53, $p < .01$; $k = .34$]. Younger patients (< 54) had a 22% ($n = 14/64$) retention rate. Fifty-nine percent ($n = 13/22$) of older patients (≥ 54) were retained at 1-year follow-up (group 3). Testing was stopped at group 3 because no other variable provided significant discrimination.

Younger patients with a mean dose of less than 59 mg/day were further divided based on physical functioning [χ^2 (1, $n = 64$) = 10.08, $p < .01$; $k = .38$]. Patients with low physical functioning (< 30) had a 60% ($n = 6/10$) retention rate (group 2), while only 15% ($n = 8/54$) of patients were retained at 1-year follow-up with high physical functioning (≥ 30 ; group 6).

4. Discussion

The current study identified two provider-related variables as the strongest predictors of retention: methadone dose and

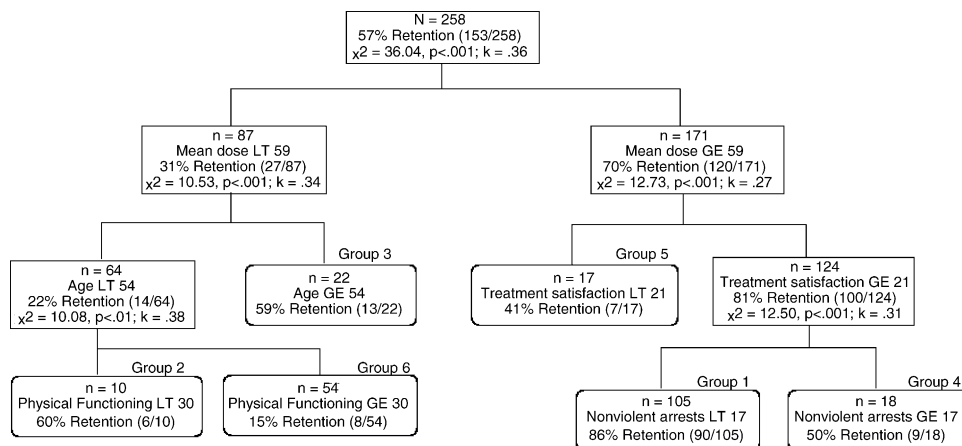


Fig. 1. ROC analysis showing subgroup discrimination. Groups are arranged from highest to lowest retention rate. N reflects the population sample examined at that particular branch of the decision tree. The cut points for each outcome variable is denoted by either GE, for greater then, or LT, for less than. Also indicated is the chi square value and kappa for each step of the analysis. In the context of an ROC analysis, kappa indicates a measure of agreement between the variables represented at each branch of the decision tree. Finally, the percentage of individuals retained in the methadone program, and the probability level at each step in the ROC analysis are presented.

treatment satisfaction. Two additional predisposing characteristics were also identified as important predictors: age and physical functioning. Previous research has found predisposing characteristics such as ethnic background and employment status to be associated with retention in methadone programs, however, these variables were not found to be significant predictors within the present ROC analysis. Finally, the number of nonviolent arrests was identified as a need characteristic predictive of retention in OAT. The current study examined need characteristics, such as psychiatric and legal problems, or enabling characteristics, such as social support and marital status, and were not found to be significant predictors within the present ROC analysis. The lack of findings for these variables that have previously been validated may point to the importance of including provider-related variables in future studies.

The finding that a methadone dose of greater than 59 mg/day predicted better treatment retention is consistent with dosing recommendations in current CPGs. These guidelines recommend a methadone dose of greater than 60 mg/day (PGTPSUD, 1995). This dose has consistently been associated with improved retention rates and better outcomes (Torrens et al., 1996; Del Rio et al., 1997; Caplehorn et al., 1998; D'Ippoliti et al., 1998; Caplehorn and Bell, 1991; PGTPSUD, 1995; Joe et al., 1991; Preston et al., 2000; Strain et al., 1999). The methadone dosing cut-off score provides convergent validity in regards to current CPGs.

To the best of the authors' knowledge, the present study is the first to utilize signal detection analysis to demonstrate treatment satisfaction as a predictor of retention. However, previous research has found that altering treatment to better address patients' treatment or lifestyle needs improves retention. For instance, individualizing treatment and providing take-home doses are both associated with increased retention rates (Condelli, 1993; Pani et al., 1996). Because the effects of patient satisfaction emerge after dosage, it appears that treatment satisfaction becomes salient for retention when dosing is appropriate. Patients receiving inadequate dosing may be less able to attend elements of treatment that are inherent in the CSQ-8, such as satisfaction with the amount, or quality, of help received. Our findings implicate patients' perception of treatment as an important element in retaining patients in OAT programs.

The current study underscores the significance of provider-related variables for increasing retention rates in OAT programs. Like other provider-related variables, dosage level and treatment satisfaction are determined from dynamic interactions between the patient and the treatment environment. Given the relationship between these factors and retention, provider-related variables merit greater attention in the behavioral model of health care utilization.

Age was also identified as a particularly strong predictor of retention. Older patients often have higher retention rates relative to younger patients. This has been hypothesized to result from increasing dissatisfaction with the addict life-style with advancing age (Mertens and Weisner, 2000; Saxon et al., 1996; Stark, 1992). Retention rates were further predicted by physical functioning. For younger patients, physical functioning is an important distinguishing factor in subgroups with high and low retention rates. While our sample contained only a few

younger patients with low physical functioning, the fact that this was detected by the ROC analysis warrants further investigation. Low physical functioning may be associated with a lack of mobility that may make drug acquisition more difficult and treatment more appealing.

The number of nonviolent arrests was the final predictive variable to emerge from the analysis, however, the cut-off score for the number of nonviolent arrests is unusually high (i.e. 17). Upon examining descriptive statistics for this variable, it was found that the majority of patients were in the 1–7 range. It is important to note, however, that previous research has demonstrated that individuals with longer conviction records are more likely to dropout of treatment (Steer, 1980).

While these analyses used the mean methadone dose as a measure of methadone exposure, there are other mechanisms that could be used to characterize methadone dose besides the average. Utilizing maximum dose, as opposed to mean dose, addresses any potential limitations due to patients being progressively withdrawn from methadone. An additional ROC analysis was run with maximum dose, in which the same categories of variables were tested for predicting retention. Treatment satisfaction and age remained significant predictors of retention. Legal problems related to participants arrest records were still found to be predictive of retention. Two common variables that were significant in this subsequent analysis include social support and mental health problems.

Two possible limitations warrant further discussion. First, the majority of the sample was male and results may not generalize to women. Second, due to the exploratory nature of the methodology, results should be interpreted with caution and await replication. Despite these limitations, ROC analysis provides a unique framework for validating two well-studied variables: age and dose. Additionally, this novel analytic approach allowed for the identification of treatment satisfaction as a strong predictor of retention.

The results of the present study suggest several areas for future research. The cut-off score for treatment satisfaction (21 out of a maximum of 32, or 66%) is not remarkably high, and seems to indicate that patients do not hold unrealistic treatment expectations. Periodically gauging patient's perception of treatment may prove to be an essential step in determining what areas can be improved. The implications for treatment tailoring also warrants attention. For instance: What can be done to retain younger methadone patients with high physical functioning? What type of individualized interventions can be developed to retain methadone patients with long conviction records?

The current study has important treatment implications for retaining patients in OAT programs, particularly in regards to treatment satisfaction. Retention remains a crucial issue because discharge from OAT programs is followed by a host of adverse consequences that have a particularly strong bearing on public health issues (Gerstein et al., 1994). Because retention is associated with better substance use outcomes, reduced criminal behaviors, and reduced spread of HIV infection, it is imperative to increase retention rates in OAT programs (PGTPSUD, 1995; Greenfield, 1999; Simpson, 1979). Identifying individuals at high risk of dropping out of OAT programs is an essential

step towards developing tailored interventions for opioid dependent patients, as well as generating hypotheses to refine current treatment configurations.

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