

Treatment setting and baseline substance use severity interact to predict patients' outcomes

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ABSTRACT

Aims This study tested the hypothesis that patients with more severe substance use disorders (SUDs) at intake respond better when treated in more structured and intensive settings (i.e. in-patient/residential versus out-patient), whereas patients with less severe SUD problems have similar outcomes regardless of treatment setting. **Design, setting and participants** Up to 50 new patients were selected randomly from each of a random and representative sample of 50 Department of Veterans Affairs (VA) SUD treatment programs (total $n = 1917$ patients), and were followed-up an average of 6.7 months later ($n = 1277$). **Measures** Patients completed a brief self-report version of the Addiction Severity Index (ASI) at baseline and at follow-up. **Findings** In mixed-model regression analyses, baseline substance use severity predicted follow-up substance use severity and there were no main effects of treatment setting. However, interaction effects were found, such that more severe patients experienced better alcohol and drug outcomes following in-patient/residential treatment versus out-patient treatment; on the other hand, patients with lower baseline ASI drug severity had better drug outcomes following out-patient treatment than in-patient treatment. Treatment setting was unrelated to alcohol outcomes in patients with less severe ASI alcohol scores. **Conclusions** Results provide some support to the matching hypothesis that for patients who have higher levels of substance use severity at intake, treatment in in-patient/residential treatment settings is associated with better outcomes than out-patient treatment. More research needs to be conducted before in-patient/residential settings are further reduced as a part of the SUD continuum of care in the United States.

Keywords Alcohol, in-patient, out-patient, treatment setting, matching, substance use.

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INTRODUCTION

Despite extensive, well-designed research, only limited support has been found for matching effects in which specific patient attributes interact with different types of substance use disorder (SUD) treatment to determine outcomes (e.g. [1,2]). However, the potential for patient characteristics to moderate the effects of setting (e.g. in-patient/residential versus out-patient) in which SUD treatment is offered has been the subject of relatively little empirical investigation (e.g. [3]).

Early research focused on the main effects of treatment settings. A review by Miller & Hester concluded that in-patient settings were not associated with better treatment outcomes relative to out-patient settings [4].

However, citing a study by Kissin, Platz & Su [5], the authors suggested that it was plausible that intensive treatment may be differentially beneficial for some subgroups of patients, such as those who were more severe and less socially stable.

Later, Finney *et al.* conducted a review of the rationales for providing in-patient versus out-patient treatment and reviewed relevant empirical studies [3]. They identified four main rationales that have been offered for the superiority of in-patient/residential treatment: (1) providing a respite for patients from harmful environments; (2) providing a setting that allows patients to receive more treatment; (3) providing medical/psychiatric care and support to patients who otherwise would not have access to such care or support; and (4) suggesting to

patients that their problems are more severe than would be implied by receipt of out-patient treatment. On the other hand, it has been argued that out-patient treatment settings should be superior because they provide a more realistic context for the patients to learn and practice new skills, resulting in greater generalization of such skills. This review identified five studies with significant main effects favoring in-patient treatment setting, two studies favoring day hospital over in-patient settings, and seven studies showing no significant setting differences in outcome. A later meta-analysis identified a modest short-term (3-month) effect size favoring in-patient over out-patient treatment on drinking-related outcomes that was not significant at later follow-up points [6].

Finney *et al.* recommended that future research should concentrate on determining whether patient intake characteristics moderate the effects of treatment settings on patient outcomes [3]. They noted that large multi-site naturalistic studies are ideal for identifying moderators of treatment setting effects because of the presence of more severe patients at baseline who, although often excluded on ethical grounds in past randomized trials of setting effects, may be the most appropriate patients for in-patient or residential treatment.

Recent evidence indicates that SUD patients' baseline severity may interact with treatment setting in relation to patients' outcomes, but effects have varied across studies. Pettinati reported that patients with multiple life-time drinking-related consequences at baseline were less likely than those with fewer drinking-related consequences to consume three or more drinks per day 3 months after treatment if they received treatment in in-patient, as opposed to out-patient, settings; however, this difference was not found at 6- and 12-month follow-ups [7]. In an outcomes monitoring project of SUD treatment programs in the state of Minnesota, Harrison & Asche [8] found no main effect of treatment setting, but there was a non-significant trend toward a higher abstinence rate among a subgroup of patients with the greatest severity (modified ASI composite) at baseline who received in-patient, as opposed to out-patient, treatment.

In a study in which patients were randomized to in-patient, intensive out-patient or standard out-patient treatment Rychtarik *et al.* [9] found, as expected, that more baseline alcohol problems predicted fewer abstinent days at follow-up for patients placed in the out-patient treatment settings (an inverse relationship); however, more severe alcohol problems at baseline predicted better drinking outcomes for patients treated in in-patient settings. McKay *et al.* [10] compared the effect of 3 weeks of in-patient treatment prior to out-patient SUD treatment to out-patient treatment only. They found that patients receiving the combination of in-patient and out-patient treatment had better outcomes overall. There also was an

interaction between baseline severity of substance use and treatment setting, such that patients with greater substance use severity at baseline who received in-patient treatment improved to a greater degree than highly severe patients who had out-patient treatment. However, because there were uncontrolled differences between the two conditions at baseline (patients who received in-patient treatment had higher severity at baseline), the authors concluded that the findings could reflect higher motivation of the patients with more severe symptoms or simply differential regression to the mean [10].

The present study was undertaken to examine a potential interaction between baseline substance use severity and treatment setting in relation to 6-month outcomes in a naturalistic, multi-site sample of patients seeking treatment for SUDs. We hypothesized that patients with more severe SUD problems would have better outcomes in in-patient/residential versus out-patient treatment settings, whereas patients with less severe SUD problems have similar outcomes across treatment settings.

This line of research is particularly timely given the current trend in many health-care systems, such as the Department of Veterans Affairs, continuing to move away from providing in-patient or residential SUD treatment [11]. It is crucial to determine whether in-patient/residential treatment settings provide (or do not provide) any differential advantage for subgroups of patients, before in-patient/residential treatment is reduced further in such systems.

METHODS

Treatment programs sampled

The current Outcomes Monitoring Project (OMP) collected baseline and 6-month follow-up data on patients in VA SUD treatment programs in three annual cohorts to evaluate a streamlined patient monitoring system. No exclusion criteria were used for patient recruitment. This study used information from the first cohort (administrative data are not yet available for the other two cohorts; for a detailed description of the cohort 1 sample and project procedures, see Tiet *et al.* [12]). A total of 322 VA SUD treatment programs were enumerated, in which 54 programs were selected randomly. Specifically, this cohort consisted of five in-patient, eight residential, six SUD domiciliary, 16 intensive out-patient, 15 out-patient and four methadone programs; however, patients from the methadone programs were excluded in the current analyses as the goal was to compare settings in which psychosocial treatment was offered. At each program, the aim was to select randomly up to 50 new patients. A total of 1917 participants were assessed at baseline from the

following settings: 244 in-patient, 390 residential, 272 SUD domiciliary, 601 intensive out-patient and 410 out-patient participants. All eligible participants in in-patient, residential and domiciliary settings were categorized as receiving in-patient/residential treatment, because they received treatment in a structured environment in which patients were monitored overnight; patients treated in standard out-patient and intensive out-patient settings were categorized as receiving out-patient treatment. Characteristics of each type of treatment setting are described below.

In-patient programs

These five programs provided intensive, acute, medicalized, in-hospital care. Data from patient records showed that the length of an average index treatment episode was 29.2 days (SD = 23.8; median = 28.0; 75th percentile = 29). Data from a program directors survey indicated that each program provided services for patients with serious comorbid psychiatric disorders; 80% of the programs provided detoxification. According to program director reports, in-patients received an average of 15.6 hours/week (SD = 15.5) of SUD treatment and attended SUD self-help groups 3.8 hours/week (SD = 1.3). An average of 62% (SD = 52.2) of patients received psychotherapy and 52% (SD = 41.3) received medications for psychiatric problems.

Residential programs

These eight programs were based in residential rehabilitation centers. They were less medicalized and patients in these programs stayed longer than in-patient programs. The average length of treatment episode was 49.8 days (SD = 54.3; median = 27; 75th percentile = 56). Data from program directors indicated that over 70% of programs provided detoxification, patients received an average of 11.1 hours/week (SD = 10.1) of SUD treatment and spent 3.9 hours/week (SD = 1.5) at SUD self-help group meetings. In all, 45.5% of patients in residential programs received psychotherapy, and 41.8% received medications for psychiatric problems.

SUD domiciliary programs

These six programs relied heavily on rehabilitation services and provided longer treatment and were even less medicalized than residential programs. Data from patient records showed the average length of treatment was 82.3 days (SD = 63.0; median = 66; 75th percentile = 134). Program director survey data indicated that half the programs provided detoxification, and patients received an average of 15.0 hours/week (SD = 21.2) of SUD treatment and spent 3.8 hours/week (SD = 2.4) in

SUD self-help group meetings. Half the patients in SUD domiciliaries received psychotherapy, 39.0% received medications for psychiatric problems and 62% received vocational or educational counseling.

Intensive out-patient programs

The 16 day-hospital programs had an average length of treatment of 71.7 days (SD = 90.1; median = 37; 75th percentile = 86). According to the program directors survey, patients in intensive out-patient programs spent an average of 2.9 days/week (SD = 1.8) at the program, receiving an average of 11.2 hours/week (SD = 6.7) of SUD treatment and spending 1.9 hours/week (SD = 2.0) in SUD self-help group meetings. About one-third (33.7%) of the patients received psychotherapy and 29.9% received medications for psychiatric problems.

Out-patient programs

Data from patient records showed that the average length of treatment at the 15 out-patient programs was 59.7 days (SD = 83.1; median = 31.5; 75th percentile = 70). Program directors reported that patients spent an average of 1.7 days/week (SD = 1.3) at their programs, receiving an average of 5.4 hours/week (SD = 6.4) of SUD treatment. In addition, out-patients spent 1.5 hours/week (SD = 1.6) in SUD self-help group meetings; 41.4% of out-patients received psychotherapy and 53.6% (SD = 22.4) received medications for psychiatric problems.

Procedure

Attempts were made to contact all patients by mail or, in fewer cases, by telephone to collect follow-up data 6 months after the administration of the baseline assessment. Eighteen participants had died during the follow-up period. Follow-up data were available on 1277 (67.2%) of the remaining participants and the mean length of follow-up was 6.7 months (SD = 1.9). Follow-up rates of patients from in-patient/residential and out-patient programs were not significantly different (64.7% versus 68.3%, respectively). Comparisons of baseline measures of participants with and without follow-up data indicated that, on average, those not providing follow-up data were 2.6 years younger (45.8 versus 48.4 years of age), less likely to be married (10% versus 23%), less likely to be non-Hispanic white (44% versus 52%) and to report more drug-related problems (0.22 versus 0.18), more employment problems (0.74 versus 0.69), but fewer psychiatric problems (0.36 versus 0.39) and fewer medical problems (0.50 versus 0.54), as measured by the Addictions Severity Index (ASI), than those with follow-up data available [13]. These two

Table 1 Comparison of baseline factors between patients receiving treatment in out-patient versus in-patient treatment settings.

Variable	Overall (n = 1277)	Out-patient (n = 691)	In-patient (n = 586)	Statistics
Age (SD)	47.8 (9.0)	47.3 (9.5)	47.3 (8.3)	NS
Female (%)	113 (9%)	67 (10%)	46 (8%)	NS
Non-Hispanic white versus other* (%)	662 (52%)	320 (47%)	342 (59%)	$\chi^2 = 17.8$; $P < 0.001$
Married (%)	288 (23%)	164 (24%)	124 (21%)	NS
Severity of alcohol problems* (SD)	0.41 (0.28)	0.36 (0.26)	0.47 (0.28)	$F = 49.4$; $P < 0.001$
Severity of drug problems* (SD)	0.18 (0.16)	0.15 (0.14)	0.21 (0.17)	$F = 46.2$; $P < 0.001$
Severity of psychiatric problems* (SD)	0.39 (0.26)	0.37 (0.26)	0.42 (0.26)	$F = 10.3$; $P = 0.001$
Severity of medical problems (SD)	0.54 (0.32)	0.54 (0.32)	0.53 (0.33)	NS
Severity of family problems* (SD)	0.30 (0.21)	0.28 (0.20)	0.32 (0.22)	$F = 11.7$; $P = 0.001$
Severity of legal problems* (SD)	0.30 (0.26)	0.32 (0.27)	0.28 (0.25)	$F = 10.3$; $P < 0.001$
Severity of employment problems* (SD)	0.69 (0.28)	0.66 (0.30)	0.72 (0.27)	$F = 15.4$; $P = 0.001$
Length of treatment* (SD)	67.45 (88.92)	72.17 (92.21)	51.78 (55.65)	$F = 67.52$; $P < 0.001$
Length of time between end of treatment and follow-up* (SD)	142.77 (81.71)	138.76 (82.59)	151.46 (78.59)	$F = 4.05$; $P = 0.04$

*Non-Hispanic white or Caucasian ethnic background versus all other ethnic backgrounds.

groups did not differ on gender, or on the ASI alcohol, family/relation and legal composites at baseline.

Measures

ASI

The ASI provides indices of alcohol, drug, psychiatric, medical, interpersonal, occupational and legal problems [13]. All composites measure problems experienced in the past 30 days and composite scores range from 0 to 1, with '0' indicating no problems and '1.0' indicating very severe problems. The ASI was selected for this project because the ASI is a widely used instrument by both researchers and clinicians, and it was being used as part of the mandated system that was the comparison condition for the streamlined patient monitoring system tested by this project [12]. These composite indices have demonstrated sound psychometric properties in both interview and self-report forms [13,14].

Demographic and service utilization information

Existing VA administrative patient databases were used to extract information on demographic and service utilization variables, such as in- and out-patient services received during the year prior to the beginning of the index episode, and during the treatment episode.

Data analyses

In order to test whether treatment setting interacted with baseline severity in relation to 6-month treatment outcomes, separate analyses were conducted for alcohol and for drug use outcomes. In each analysis, mixed-model regression was used to account for shared variance due to treatment site. ASI composites were median-centered and

treatment setting, as a binary variable, was coded -0.5 (out-patient) and 0.5 (in-patient) to ensure accurate interpretation of the findings [15]. After accounting for the effect of treatment site, the following variables were used to examine the interaction effect on follow-up alcohol ASI composite scores: baseline alcohol ASI composite, treatment setting (out-patient versus in-patient/residential) and baseline alcohol ASI composite \times treatment setting. In addition, because demographic factors and pre-treatment functioning levels in all domains measured by the ASI may influence treatment outcomes, all variables that were significantly different between in-patient/residential and out-patient setting patients at baseline (see Table 1) were controlled in the analyses, as was the length of index treatment episode and the length of time between the end of treatment episode and follow-up data collection. A similar equation was used to predict follow-up drug ASI.

Although a standard method of calculating R -squared (variance accounted for by the models and the parameters) has not been established for mixed effect regression models, we calculated the total variance explained by squaring the correlation of the observed and fitted values [16]. Regions of significance analyses were conducted to examine at which points on the baseline ASI continuum the in-patient/residential and out-patient regression lines began to differ significantly [17,18]. The specific software used is available at <http://www.unc.edu/~preacher/index.htm>. To minimize potential biases due to missing data, a model-based multiple imputation procedure was used to estimate missing data, because this procedure has been shown to provide more efficient, accurate and reliable inferences than other methods [19,20]. Analyses were re-conducted on imputed data to confirm primary findings.

Table 2 Prediction of follow-up alcohol use severity using mixed-model regression techniques to account for shared variance due to treatment site.

Variable	Estimate	SE	t	Significance	95% CI
Prediction of follow-up alcohol use severity					
Severity of baseline alcohol problems	0.15	0.02	7.27	0.00	0.11 to 0.20
Treatment setting (out-patient = $-1/2$; in-patient = $1/2$)	-0.02	0.01	-1.37	0.18	-0.04 to 0.01
Baseline severity \times treatment setting	-0.14	0.04	-3.50	0.00	-0.22 to -0.06
Covariates					
Non-Hispanic white versus other	0.01	0.01	1.03	0.31	-0.01 to 0.03
Severity of baseline drug problems	-0.05	0.04	-1.39	0.17	-0.13 to 0.02
Severity of baseline psychiatric problems	0.05	0.02	2.03	0.04	0.00 to 0.10
Severity of baseline family problems	-0.01	0.03	-0.41	0.69	-0.07 to 0.05
Severity of baseline legal problems	-0.02	0.02	-0.94	0.35	-0.06 to 0.02
Severity of baseline employment problems	0.04	0.02	1.82	0.07	-0.00 to 0.08
Length of treatment	0.00	0.00	0.23	0.82	-0.01 to 0.01
Length of time between end of treatment and follow-up	0.01	0.00	2.75	0.01	0.00 to 0.01

$n = 1277$; $-2 \log \text{likelihood} = -527.86$.

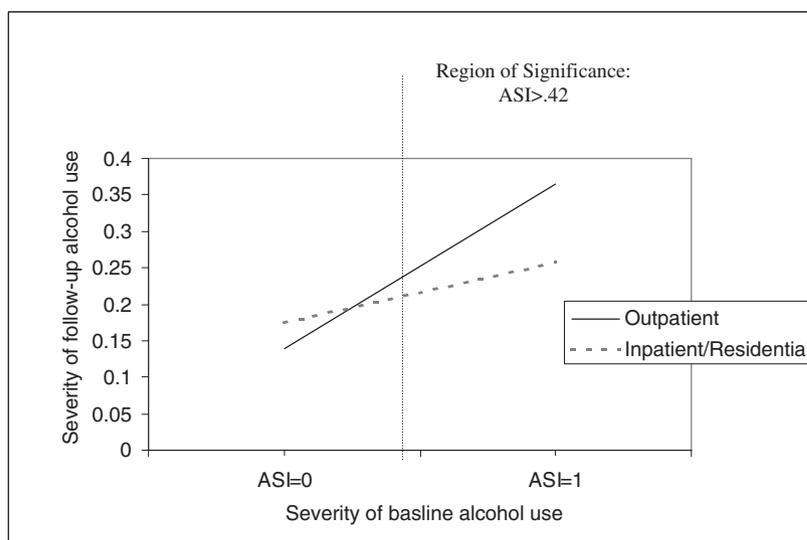


Figure 1 Interaction effects of treatment setting and ASI alcohol problem severity at baseline on ASI alcohol problem severity at 6-month follow-up.

RESULTS

Table 1 shows that patients receiving treatment at in-patient/residential settings were more likely to be non-Hispanic white, reported more alcohol, drug, psychiatric, family and employment problems, but less legal problems, and received treatment over a shorter period, compared to patients who received treatment in out-patient settings. Not surprisingly, length of time between end of treatment and follow-up assessment was longer for patients who received in-patient/residential treatment than patients who received out-patient treatment. The two groups did not differ on age, gender, marital status and ASI medical composite scores at baseline

Severity of alcohol use

The results of the analyses predicting follow-up alcohol severity are shown in Table 2 and Fig. 1. Controlling for

ethnicity, ASI drug, psychiatric, family, legal and employment composites at baseline, the length of index treatment episode and the length of time between the end of treatment episode and follow-up data collection, greater baseline severity of alcohol problems was associated with greater severity of alcohol problems at follow-up [$t_{(1,1143)} = 7.3$, $P < 0.001$]. The main effect of treatment setting was not significant. However, a significant interaction was found between baseline severity of alcohol problems and treatment setting [$t_{(1,1151)} = -3.5$, $P < 0.001$]. The interaction term accounted for 0.3% of the total variance. Region of significance analyses showed that the regression lines became significantly different when the baseline ASI alcohol score was greater than 0.42. Among patients who had an ASI scores of greater than 0.42 at baseline, patients who were treated in out-patient settings ($n = 254$) had a mean score of 0.66 at baseline and 0.28 at follow-up, whereas those

Table 3 Prediction of follow-up drug use severity using mixed-model regression techniques to account for shared variance due to treatment site.

Variable	Estimate	SE	t	Significance	95% CI
Prediction of follow-up drug use severity [2]					
Severity of baseline drug problems	0.18	0.02	9.55	0.00	0.14 to 0.22
Treatment setting (out-patient = $-1/2$; in-patient = $1/2$)	0.01	0.01	1.69	0.10	0.00 to 0.03
Baseline severity \times treatment setting	-0.10	0.04	-2.70	0.01	-0.17 to -0.03
Covariates					
Non-Hispanic white versus other	-0.01	0.01	-1.57	0.12	-0.02 to 0.00
Severity of baseline alcohol problems	-0.02	0.01	-2.21	0.03	-0.04 to -0.00
Severity of baseline psychiatric problems	0.02	0.01	1.82	0.07	-0.00 to 0.05
Severity of baseline family problems	0.00	0.01	0.02	0.98	-0.03 to 0.03
Severity of baseline legal problems	-0.00	0.01	-0.46	0.65	-0.03 to 0.02
Severity of baseline employment problems	0.01	0.01	0.75	0.46	-0.01 to 0.03
Length of treatment	-0.00	0.00	-1.53	0.13	-0.01 to 0.00
Length of time between end of treatment and follow-up	-0.00	0.00	-1.90	0.37	-0.00 to 0.00

$n = 1277$; $-2 \log$ likelihood = -2327.06 .

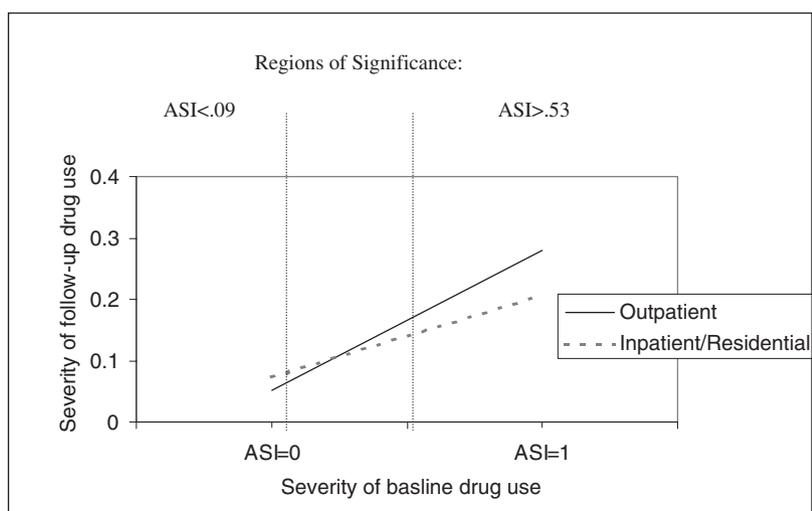


Figure 2 Interaction effects of treatment setting and ASI drug problem severity at baseline on ASI drug problem severity at 6-month follow-up

who were treated in in-patient/residential settings ($n = 328$) had a mean of 0.68 at baseline and 0.23 at follow-up. Analyses including imputed outcome data had almost identical results, and the interaction between baseline severity of alcohol problems and treatment setting continued to be statistically significant [$t_{(1,1151)} = -3.64$, $P = 0.0003$, $CI = -0.23$ to -0.07].

Severity of drug use

The results of the analyses predicting follow-up illicit drug severity are shown in Table 3 and Fig. 2. Controlling for ethnicity, ASI alcohol, psychiatric, family, legal and employment composites at baseline, length of index treatment episode and the length of time between the end of treatment episode and follow-up data collection, baseline ASI drug scores significantly predicted ASI drug scores at follow-up [$t_{(1,1227)} = 9.6$, $P < 0.001$]. The main effect of treatment setting was not significant, but drug

composite scores at follow-up were predicted by the interaction between treatment setting and baseline drug composite scores [$t_{(1,1176)} = -2.7$, $P < 0.01$]. The interaction term accounted for 0.2% of the total variance. Region of significance analyses showed that the regression lines were significantly different when the baseline ASI score was either below 0.09 or above 0.53. Among patients who had an ASI score of below 0.09 at baseline, those who received out-patient treatment ($n = 306$) had a mean score of 0.04 at baseline and 0.05 at follow-up, whereas those who received in-patient/residential treatment ($n = 187$) had a mean score of 0.03 at baseline and 0.06 at follow-up. Among patients who had an ASI score of above 0.53 at baseline, those who received out-patient treatment ($n = 9$) had a mean score of 0.62 at baseline and 0.15 at follow-up, whereas those who received in-patient/residential treatment ($n = 28$) had a mean score of 0.63 at baseline and 0.09 at follow-up. Analyses

including imputed outcome data yielded almost identical results, and the interaction between baseline severity of drug problems and treatment setting continued to be statistically significant [$t_{(1,1176)} = -2.32$, $P = 0.021$, $CI = -0.15$ to -0.01].

Supplementary analyses

Post-hoc analyses were conducted to examine whether the general findings were driven by a single in-patient/residential setting of care. Interactions were computed for baseline severity and each type of in-patient/residential care (in-patient, residential, domiciliary) versus out-patient setting. For ASI alcohol outcomes, the interaction terms involving residential versus out-patient ($P = 0.001$) and domiciliary versus out-patient ($P = 0.004$) treatment were significant, but not the interaction between baseline severity and in-patient versus out-patient treatment. For ASI drug outcomes, the interaction terms involving in-patient versus out-patient ($P = 0.003$) and residential versus out-patient ($P = 0.022$) treatment were statistically significant, but not the interaction between baseline drug severity and domiciliary versus out-patient treatment. Thus, the findings were not driven by a single in-patient/residential setting of care.

Discriminant function analyses were conducted to examine the degree of confounding between important clinical variables and the levels of care to determine whether all the cases at extreme levels of alcohol problems, or extreme levels of drug problems, ended up in the in-patient/residential group. Alcohol, drug, psychiatric and medical ASI scores were used to predict in-patient/residential versus out-patient treatment settings. The canonical discriminant function results showed that the means of the composite scores were 0.22 (SD = 1.05) for in-patient/residential settings and -0.20 (SD = 0.95) for out-patient settings. The composite scores did not predict accurately the group membership of treatment settings; 58.6% of the cases were classified correctly. Seventy per cent of the out-patients and 46% of the in-patients were predicted correctly.

To rule out a competing hypothesis that patients who received in-patient care showed more improvement because many of them had an extensive history of prior treatment, we conducted three-way interaction analyses of treatment setting (in-patient/residential versus out-patient) \times severity (alcohol or drug) \times SUD treatment in the 12 months prior to baseline data collection at the beginning of the index episode. Three-way interactions were not statistically significant ($P = 0.888$ and $P = 0.179$ for alcohol and drug, respectively) and the findings did not change, such that the two-way interactions between treatment setting (in- versus out-patient) and severity (alcohol or drug) continued to be statistically

significant ($P = 0.001$ and $P = 0.005$, for alcohol and drug, respectively).

DISCUSSION

This study provides some support for matching substance use disorder patients to treatment settings. Patients with higher levels of SUD severity had significantly better 6-month outcomes if they were treated in in-patient/residential treatment settings rather than in out-patient settings, and patients with lower levels of drug severity had significantly better 6-month drug outcomes if they were treated in out-patient treatment settings. Although patients were not classified using the patient placement criteria (PPC) from the American Society of Addiction Medicine (ASAM), the current findings are consistent with guidelines recommended by the ASAM PPC and findings from studies on the matching of patient characteristics following these guidelines. For example, Sharon *et al.* [21] found that patients who were mismatched to a less intensive level of care than recommended by the ASAM PPC utilized more hospital bed-days in the subsequent year.

The severity–setting interaction effects in this study were significant, but they were not strong. However, the magnitude of the interaction effects of the current study as indicated by the proportion of variance accounted for (0.2% for drug and 0.3% for alcohol) are at, and above, the median (0.2%) of the moderating effects involving categorical variables among 261 studies between 1969 and 1998 that were reviewed [22]. The small effect sizes of this and previous studies are due to many unavoidable design, measurement and statistical artifacts that bias the observed moderating effects downwards, such as measurement errors and heterogeneity of the study population [22]. The apparently small interaction effects, nonetheless, may have real practical and clinical implications for some patients. The region of significance analyses indicate that only in patients with ASI alcohol composite scores greater than 0.42 at intake and only in patients with baseline ASI drug composite scores greater than 0.53 was there an advantage to receiving treatment in in-patient/residential settings. Thus, it is a relatively small subgroup of patients who appear to benefit from in-patient/residential treatment more than from out-patient treatment. Patients who had low drug severity at baseline had slightly better outcomes when treated at out-patient instead of in-patient/residential settings; however, the in-patient group with low drug severity also had higher alcohol severity than the out-patient group at baseline (mean = 0.46 and 0.34, respectively). Having less alcohol problems and being in a more realistic out-patient setting to learn and practice new skills may be more beneficial for the patients who have lower drug severity.

If replicated by future studies, the findings presented here highlight the importance of in-patient/residential treatment for certain patients. Early reviews of the role of treatment setting argued that the added cost of in-patient treatment was not justified because there was no evidence for increased effectiveness of this form of treatment over more affordable out-patient treatment [4,23]. Third-party payers used these results to not cover intensive residential treatment [4]. As a result, the availability of in-patient treatments decreased in large nation-wide health-care systems. For example, the Veterans Health Administration operated 180 in-patient programs in 1994 in contrast to 15 programs in 2003 [11,24]. Although the number of residential programs increased during this period, it did not completely offset the loss of in-patient beds.

Evaluations of cost-effectiveness of different settings of care are short-sighted if they attend only to the main effects of treatment setting and fail to identify specific patient populations for whom in-patient treatment setting is particularly important [5]. Moreover, residential treatment can be offered at a much lower cost than medically oriented in-patient treatment. The present findings are part of a growing body of literature indicating that patients with more severe baseline substance use problems have a differentially positive outcomes to in-patient/residential treatment compared to out-patient treatment [8–10].

The present results should be interpreted with caution for several reasons. First, the 67% follow-up rate is a limitation. Clinical trials usually achieve more than 80% follow-up rates. However, clinical trials such as Project MATCH usually have many exclusion criteria (e.g. homelessness, comorbid serious mental illness, etc.), which result in a low percentage of screened individuals actually participating in the trial. In Project MATCH, only 39% of the individuals who were screened participated [2]. On the other hand, some previous patient outcome monitoring data, such as data from this project, have attempted to follow-up virtually all patients, and tend to have lower follow-up rates. For example, Department of Veterans Affairs SUD program treatment staff achieved follow-up rates of 15–21% over three cohorts of a mandated system between October 1997 and September 2000 [25,26]. Thus, the 67% follow-up rate here is good for an outcomes monitoring system.

Secondly, the low proportion of women in the sample may limit the generalizability of the findings. Thirdly, the assessment of substance use here was based on patient self-report and not corroborated by collateral or physiological measures; however, self-report measures of substance use have been shown to be valid under program evaluation or research conditions [27–29]. Fourthly, the design of the present study was naturalistic. Even after

controlling for observed baseline difference between patients in the two broad settings, it is possible that we did not eliminate completely a selection bias in which patients selected treatment settings that might be more or less beneficial. Fifthly, patients in the present study were followed for only a little over 6 months, on average; more data on the stability of interaction effects over longer intervals are needed. Sixthly, a finer distinction within the broader grouping of in-patient/residential or out-patient treatment settings was not made in this study, due to the limited number of treatment programs in each setting (e.g. only five in-patient programs). Future studies should examine more specific setting effects within these broader groupings, such as between intensive out-patient and standard out-patient treatment settings. Finally, the specific aspects of in-patient/residential treatment that were particularly beneficial for treating patients with more severe baseline substance use disorders were not identified and warrant future investigation.

Despite these limitations, the finding that treatment setting interacted with baseline severity of substance use is an important demonstration that in-patient/residential treatment may have specific benefits for certain individuals. Although the present results require further replication on other samples and for longer follow-up periods, they provide evidence that in-patient/residential treatment may be an important part of the continuum of care and may serve a vital role in the treatment of patients with more severe substance use disorders.

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