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Effects of Receiving Additional Off-Site Services on Abstinence from Illicit Drug Use Among Men on Methadone: A Longitudinal Study

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Abstract

Health and psychosocial service needs that may be co-morbid with opioid addiction may impede the success of drug treatment among patients attending methadone maintenance treatment programs (MMTPs). This longitudinal panel study investigates whether receipt of services from one or more helping professionals outside of the MMTP confers a benefit for drug treatment outcomes among a random sample of male MMTP patients ($N = 356$). Each participant was interviewed 3 times, with 6 months between each interview. Since this observational study did not employ random assignment, propensity score matching was employed to strengthen causal validity of effect estimates. Results support hypotheses that receiving additional off-site services has significant beneficial effects in increasing the likelihood of abstaining from cocaine, heroin, and any illicit drug use over both the ensuing 6 month and 12 month time periods. These findings indicate that receipt of additional medical and/or psychosocial services enhances the efficacy of methadone treatment in increasing abstinence from illicit drug use.

Keywords

methadone; health services; drug abstinence; opioid-related disorders

1. Introduction

Although lifetime of heroin use in the U.S. appear to have roughly plateaued in recent years at the highest levels since the 1970s (Substance Abuse and Mental Health Services Administration, 2003, 2004), past month prevalence rates of heroin use have increased significantly from 2005 to 2006 (Substance Abuse and Mental Health Services Administration, 2007). Among single categories of illicit drugs, recent data also suggest that past month prevalence rates of non-prescription use of pain relievers is second only to marijuana use, with a significant increase from 2005 to 2006 among all pain relievers as well as for the opioid analgesic OxyContin (Substance Abuse and Mental Health Services Administration, 2007). According to a recent report (Substance Abuse and Mental Health Services Administration,

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2004), among past year heroin users, the proportion who are dependent is 57.6%, a figure which is more than twice as high as the estimate for the next highest proportion (27.5% for cocaine). Studies consistently demonstrate that methadone treatment for opioid abuse is one of the most effective (Institute of Medicine, 1995; National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction, 1998) and cost-beneficial means to address opioid addiction (Barnett & Hui, 2000; Joseph, Stancliff, & Langrod, 2000).

Research with patients attending methadone maintenance treatment programs (MMTPs) has documented high levels of need with respect to physical health (Aszalos, McDuff, Weintraub, Montoya, & Schwartz, 1999; Gearing & Schweitzer, 1974; Hagen & Des Jarlais, 2000; Joseph et al., 2000; Novick, 2000), psychological or mental health (Ball & Ross, 1991; Brooner, King, Kidorf, Schmidt, & Bigelow, 1997; Calsyn, Wells, Fleming, & Saxon, 2000; Milby et al., 1996; Schiff, El-Bassel, Engstrom, & Gilbert, 2002), and other psychosocial difficulties (Ball & Ross, 1991; El-Bassel et al., 2001; El-Bassel, Gilbert, Schilling, & Wada, 2000; Joseph et al., 2000; Widman, Platt, Lidz, Mathis, & Metzger, 1997). These needs, if unmet, are thought to be related to continued drug use or relapse (Joe, Simpson, & Sells, 1994; Saxon, Wells, Fleming, Jackson, & Calsyn, 1996; Wasserman, Korcha, Havassy, & Hall, 1998) and/or dropout from methadone treatment (Joe, Simpson, & Hubbard, 1991; McLellan, 1983; Simpson et al., 1997). These propositions appear to be supported by several randomized clinical trials (RCTs) that have demonstrated beneficial outcomes when health, psychosocial, and/or behavioral services were provided in conjunction with methadone treatment (McLellan et al., 1993; Umbricht-Schneiter, Ginn, Pabst, & Bigelow, 1994; Woody et al., 1983; Woody, McLellan, Luborsky, & O'Brien, 1995). Furthermore, greater provision of psychosocial support services in MMTPs has been found to be more cost-effective than methadone treatment alone or with lower levels of support services (Kraft, Rothbard, Hadley, McLellan, & Asch, 1997; Shepard, Larson, & Hoffmann, 1999). Similar findings have been reported among a wider range of substance abuse treatment venues as well (Broome, Simpson, & Joe, 1999; Friedmann, Alexander, Jin, & D'Aunno, 1999; J. C. Marsh, Cao, & D'Aunno, 2004; J.C. Marsh, D'Aunno, & Smith, 2000; McLellan et al., 1998; Smith & Marsh, 2002).

In spite of the demonstrated value of additional services, the provision of additional services within MMTPs has decreased in recent years (Etheridge, Hubbard, Anderson, Craddock, & Flynn, 1997), most likely as a result of cost containment and unit cost reduction efforts. To compensate, the trend has been to refer or rely on off-site service providers. However, the question of whether receipt of services from service providers outside of the MMTP improves drug treatment outcomes among methadone clients has not been answered. This study seeks to examine the effects of receiving additional off-site services among MMTP patients. To this end, this study tests hypotheses regarding the effect of receiving additional off-site services on likelihood of subsequently abstaining from illicit drug use among a random sample of men on methadone. We employed propensity score matching to minimize bias arising from the non-experimental design of the study.

2. Methods

2.1 Design and study population

Data were collected as part of a longitudinal, panel study (conducted between 1999–2004) originally designed to examine the relationships among substance abuse, intimate partner violence, and HIV risks among a random sample of male MMTP patients (see El-Bassel et al., 2001) for more information about the parent study). Study participants were patients attending one of seven MMTPs, operating under the same healthcare provider, located in the Harlem area of New York City (NYC). Of the randomly selected 1,300 men from the list of 2,067 male patients enrolled in the seven MMTPs; 774 were reached and agreed to completed a 15-minute screening interview to determine eligibility for the main phase of the study. Eligibility criteria

for the main phase were: (1) being male aged 18 or over; (2) being enrolled in an MMTP for at least three months; and (3) during the past year, having had a sexual relationship with a woman whom the man described as his girlfriend, spouse, regular sexual partner, or the mother of his children. A total of 356 men met eligibility criteria and agree to participate in the longitudinal study, which consisted of a 90 minute, face-to-face structured interview conducted within a week of screening (i.e., “baseline”) and similar follow-up interviews six and twelve months later. The Institutional Review Boards of the participating MMTPs and Columbia University (the research institution) approved the protocol for this study, and all participants provided informed consent prior to each interview.

2.2 Procedures

Interviews were conducted by trained, male research assistants in a private office located in the MMTP or, if the participant preferred, a private interview room located at the research institution. Each structured interview elicited self-reported data on the measures described below. Participants were compensated \$5 for completing the screening interview. During the main phase of the study, participants were given a Metrocard (value = \$4) at each interview to cover the cost of transportation. In addition, participants received \$25 upon completion of the baseline interview, \$35 for the 6-month follow-up interview, and \$50 for the 12-month follow-up interview. Retention rates at follow-up were 81% (n = 287) and 79% (n = 280) at 6- and 12-month follow-up timepoints respectively.

2.3 Measures

Sociodemographic data collected included age; race/ethnicity; years of formal education; current employment status (0 = unemployed; 1 = employed “either on or off the books”); monthly income; whether the participant had health insurance; and marital status (0 = Single, never married; 1 = divorced, separated, or widowed; 2 = legally or common-law married). Other background variables included duration of current methadone treatment and current methadone dose. Sociodemographic data were collected at screening and baseline.

In addition to the aforementioned sociodemographic variables, analyses described below included variables that may capture different levels of service needs that, in turn, may differentially affect receipt of additional services, thus potentially confounding the observed relationships between receipt of services and outcome variables in an observational (i.e., non-randomized controlled) study. HIV status was ascertained based on participants’ self-reports. Using the Stressful Life Events Checklist (SLEC) from the Posttraumatic Stress Diagnostic Scale (Foa, 1995), participants were asked whether they experienced each of a specific series of 20 stressors or stressful events prevalent within urban, impoverished communities (e.g., serious illness or injury, physical assault, homelessness) during the six months prior to assessment. Psychological distress was assessed using the Brief Symptom Inventory (BSI) (Derogatis, 1993), which assesses severity—over the prior 7 days—of 53 psychological distress symptoms; analyses used the Global Severity Index of the BSI, which represents the average severity of all 53 symptoms.

The independent variable of receipt of additional off-site services used participants’ responses to a single question—asked during the study’s eligibility screening step that immediately preceded study enrollment and baseline—about frequency of visits over the prior six months to any of the following: a physician; psychiatrist, psychologist, or other mental health professional; social worker; priest, minister, or other spiritual leader; and “some other helping professional” outside of the MMTP clinic. Although the MMTP clinics have a physician and nurses on site, service utilization focused on visits to service providers outside of the MMTP clinics to avoid the confounding effects of visits mandated as part of treatment (i.e., a single, physical examination by the attending physician upon MMTP enrollment). Responses to the

receipt of off-site services were collapsed into two categories: 0 = no visit; and 1 = at least 1 visit, herein referred to as “recipients” and “non-recipients” of additional, off-site services respectively.

For the dependent variables, use of illicit drugs was assessed using the Drug Use and Risk Behavior Questionnaire (El-Bassel et al., 2000), covering self-reported frequency of crack, cocaine, heroin, and marijuana use during the 6 months prior to assessment. A participant scored positive for use of a particular drug if he reported use of that drug in the prior 6 months. An “any illicit drug use” measure was created collapsing across the individual drug use categories using the Boolean OR operator. For clarity and ease of comprehension, results in the final analyses describe (non-)use of drugs: participants who reported no use of a specific drug were coded as “abstinent” for that specific drug and time period; the attribute for abstaining from any illicit drug use was calculated by collapsing across abstinence measures for each drug using the Boolean AND operator. Illicit drug use was assessed during the baseline, 6-month, and 12-month assessment interviews.

2.4 Analyses

This study sought to employ techniques that strengthen the internal validity of findings, i.e., minimize potential bias with respect to the effect of receipt of additional, off-site services on illicit drug use. To that end, several considerations guided the final analysis plan. First, we sought to account for missing data due to attrition, whose underlying mechanism may lead to non-ignorable non-response with respect to parameter estimation. Second, since this was a non-experimental study—i.e., an observational study that lacked random assignment—care must be taken to ensure that parameter estimates are not biased due to self-selection and other confounders. Third, analyses receipt of additional, off-site services that preceded illicit drug use measures in order to establish the correct temporal sequencing of events

Missing data—To minimize the potential for generating biased parameter estimates, as well as ensuring that calculations account for the uncertainty due to missing observations, we used multiple imputation (MI) (D. Rubin, 1987; Shafer, 1997) before conducting analyses. In implementing MI, we created five full (i.e., screening, baseline, 6-month and 12-month follow-up) datasets in which each instance of a missing value was imputed. In MI, imputed values are generated by using the information that is observed or measured for a participant in order to predict values in instances for which that individual’s information is missing. MI relies on more plausible assumptions than *ad hoc* imputation methods such as complete-case analysis, missing value treated as failure, or last-observation carried forward (Little & Rubin, 2002). Moreover, because MI replaces each missing value with several imputed values, MI effectively propagates the uncertainty about the missing values, thus leading to more appropriate standard errors compared to *ad hoc* and/or single imputation techniques for handling missing data. MI was performed using multivariate imputation by chained equations (MICE) for Stata (Royston, 2004; van Buuren, Boshuizen, & Knook, 1999).

Propensity score matching—In any non-experimental study, “naïve” attempts (e.g., difference in group means) to estimate effects of a predictor variable—in this case, receipt of additional, off—site services—can result in biased estimates due to selection bias and/or effects of confounders whose net result is that the group of recipients is not comparable to the non-recipients of additional, off-site services. Attempting to control for these differences by relying solely on covariance adjustment in regression equations has been shown to be flawed because such approaches rely on strong parametric assumptions (for example, linearity), and, when groups are very dissimilar, may force extrapolations of the model over portions of the covariate space where there are no data (Dehejia & Wahba, 1999; D. B. Rubin, 1979).

To address these issues, we employed propensity score matching (Dehejia & Wahba, 1999; Rosenbaum & Rubin, 1983, 1985) before estimating effects of service utilization on subsequent illicit drug use. Briefly, propensity scores—formally, the probability that a person belongs to a group sharing a specific attribute on the predictor variable of interest conditional on attributes for confounder variables—for each individual are calculated using logistic regression of the service utilization on the confounding covariates. Separate regression models were created for each outcome variable, i.e., each specific drug as well as any illicit drug use; in each regression model, the set of confounder variables included all sociodemographic variables (note: statistical models used $\ln(\text{income} + \$1)$, an approach widely used in the econometrics literature (Weichselbaumer & Winter-Ebmer, 2005) and covariates described above, as well as the attribute for drug use variable reported at baseline. Then, for each participant who reported receiving additional, off-site services, the participant in the group of non-recipients who has the closest propensity score is chosen for inclusion in the comparison group (i.e., nearest-neighbor matching). We used matching with replacement, which tends to yield less biased estimates than matching without replacement (Dehejia & Wahba, 1998). In these procedures, unmatched individuals are therefore not included, resulting in a different sample size for each analysis; from a causal inference perspective, inclusion of data from these non-comparable individuals in analyses would result in invalid estimates.

Because propensity score matching creates two groups (recipients and non-recipients of additional, off-site services) who have similar values for observed confounders, this method, in effect, “reconstructs” a sample that mimics the results of a randomized clinical trial. To confirm whether the matching has been successful, the covariate distributions should be compared across the matched groups. For this study we used two tests, the Kolmogorov-Smirnov and Shapiro-Wilk tests, to confirm that the matching procedures resulted in groups that were substantially similar on average with respect to confounders and differed only with respect to the predictor variable of interest.

Estimation of effects—After propensity score matching, we employed binary logistic regression analyses to test hypotheses regarding the effect of receipt of additional, off-site services (measured during the study’s first phase) on abstaining from drug use using data obtained at the 6 month follow-up interview (i.e., during months 0 to 6), the 12-month follow-up interview (i.e., during months 6 to 12), as well as the combination of the two (i.e., during the entire 12 month period following assessment of service utilization). Separate regression models were conducted for each drug as well as any illicit drug use. Each model included covariance adjustment using the same variables used for propensity score matching. Findings are presented as adjusted odds ratios (*ORs*) and their corresponding 95% confidence intervals (95% *CIs*).

3. Results

The sociodemographic characteristics of the study sample are presented in Table 1. The characteristics of this sample are very similar to the overall patient population at the participating MMTP clinics with respect to age, race/ethnicity, current treatment duration, and methadone dose (data from clinic records regarding other sociodemographic and health indicator variables were unavailable to study staff for comparison). Several indicators suggest a high prevalence of service needs among the sample: almost half (47%) were unemployed; an average of slightly more than one type stressful life event in the prior six months; an average level of psychological distress that is more than one standard deviation higher than that observed in the general population of men in the U.S. (Derogatis, 1993); and an HIV prevalence of 14%.

Compared to participants who reported not receiving additional, off-site services, recipients of such services had significantly more years of education, reported significantly more types of stressful life events and psychological distress, and were significantly more likely to be HIV-positive.

With respect to illicit drug use among the study sample, the most frequently reported was heroin, followed in decreasing order of prevalence by marijuana, cocaine, and then crack. Overall, about two-thirds of the participants used some type of illicit drugs at the baseline and 6-month follow-up timepoints (66% and 67% respectively), with a lower prevalence at the 12-month follow-up timepoint (62%). Table 2 provides estimates of the prevalence of illicit drug use separated by type of illicit drug (and any illicit drug use) and timepoint among the entire sample as well as subgroups separated by receipt of additional, off-site services.

Table 3 presents estimates of the causal effect (i.e., after propensity score matching and covariance adjustment for potential confounders) of receipt of additional, off-site services on the likelihood of abstaining from the indicated drug or any illicit drug use over various ensuing time periods. Beneficial effects of receipt of additional, off-site services was observed for all outcome measures during the first six months, with likelihood of abstaining from cocaine, heroin, and any illicit drug use exceeding the criterion level for significance. During the period encompassing six to twelve months following receipt of additional, off-site services, point estimates of the effects of receiving such services were in the beneficial direction all outcome measures, although only the increase in likelihood of abstaining from any illicit drug use was significant at the 95% confidence level. With respect to likelihood of abstaining from drug use during the entire, subsequent 12 month period, recipients of additional, off-site services were more than two and a half times as likely to abstain from cocaine and heroin use, and more than three and a half times as likely to abstain from any illicit drug use; estimates for abstaining from crack and marijuana use were also in the beneficial direction, but did not at the 95% confidence level.

An eligibility criterion for the parent study required that potential participants current methadone treatment be at least 3 months. Since the time frame for measuring receipt of additional, off-site services was assessed at screening and covered a 6 month period, we examined the extent to which findings might be affected by receipt of additional, off-site services before initiation of methadone treatment. Only 5 of the participants in this study were on methadone for 6 months or less: 3 were non-recipients and 2 were recipients of additional off-site services. Results and inference remain unchanged if the 5 participants who were on methadone for 6 months or less are withheld from analyses.

Several additional steps were implemented to examine the validity of these findings. First, balance between the recipients and non-recipients of additional, off-site services after propensity score matching indicated that the groups were balanced (i.e., not significantly different) with respect to attributes for variables used for propensity score matching and covariance adjustment, including variables for which significant differences were observed before the propensity scoring matching process (e.g., level of education, SLEC score, etc.). Second, to address the potential problem of non-overlap in propensity scores between recipients and non-recipients of additional, off-site services, analyses were re-run while excluding service users whose propensity score fell outside of the range of propensity scores of non-service users. Third, instead of nearest neighbor matching, we employed caliper matching using widths that range from ± 0.02 to ± 0.10 . Sensitivity analyses implementing the latter two steps indicate that the findings presented in Table 3 remained remarkably consistent. In some instances, significant findings in Table 3 no longer reached significance at the 95% confidence level. However, since estimates of the adjusted *ORs* in those instances changed no more than 20% (and less than 10% for the vast majority of estimates)—and in no case did the

point estimate change from the observed beneficial direction (i.e., adjusted $OR > 1$) to a detrimental direction (i.e., adjusted $OR < 1$)—we posit that the essential relationships, and thus our conclusions, remain unchanged and that the lack of significance observed is due to the decrease in power stemming from the smaller sample sizes in models that exclude participants with non-overlapping propensity scores or no matches falling within the caliper width.

4. Discussion

To our knowledge, this is the first study to report the effects of off-site supplemental service utilization on illicit drug use among men in methadone treatment. Given that this was an observational study that did not employ random assignment, we have endeavored to employ methods that maximize the strength and validity of causal inference. Specific steps included: random sampling to enhance external validity, longitudinal design to establish correct temporal sequencing of events, multiple imputation minimize bias due to missing data, and propensity score matching to avoid effects of selection bias (between service users vs. non-service users) and potential confounder variables. Findings from this study support hypotheses regarding the positive effects receiving additional, off-site services with respect to increasing the likelihood of abstaining from illicit drug use in general as well as specifically for cocaine and heroin. Significant beneficial effects of receiving additional, off-site services were observed not only in the ensuing 6 months, but also detectable when measuring abstinence over the 12 month period following supplemental service utilization. During the 6 to 12 month period following receipt of additional, off-site services, significant effects on engaging in illicit drug use were only observed when examining any illicit drug use. Failure to observe significant differences may result from non-recipients subsequently receiving, off-site services during months 0 to 6—which may lead to a decrease in illicit drug use during months 6 to 12—rather than relapse among the original group of supplemental service users. We note that all point estimates for the effects on each individual drug were in the beneficial direction, and thus, our substantive conclusions regarding the benefits of receipt of additional, off-site services remain unchanged. Nevertheless, findings from this study substantiate the need for further research to delineate more definitively whether effects at discrete longer-term periods is simply smaller (and hence requiring only greater sample size/statistical power to detect significant differences) versus an alternative scenario in which there is a fundamental change in the relationship between receipt of additional, off-site services and subsequent likelihood of illicit drug use at discrete, longer-term follow-up periods.

4.1 Limitations

Before a discussion of the implications from these findings, several limitations are worth noting. Although prior research has shown that self-reported data about drug use can be reliable and valid (Darke, 1998; Hser, Maglione, & Boyle, 1999; Johnson et al., 2000), the validity of drug use measures nonetheless would be strengthened with the use of objective, biological assays (e.g., urine toxicology). Another limitation stems is the lack of random assignment or allocation. Propensity score matching represents a state-of-the-art approach to causal inference using data from an observational study without random assignment to a “treatment” of interest (i.e., receipt of additional, off-site services), but the causal validity of estimates using propensity score matching relies on confounders being measured; despite our efforts to include a comprehensive set of sociodemographic and other proxies/variables (e.g., psychological distress) for factors drive receipt or non-receipt of additional, off-site services, the possibility remains that some factor(s) may not have been measured; furthermore, matching over a collection of multiple variables may still leave imbalance on an individual variable. We note that such limitations also exist in theory for randomized controlled trials in which there may be a chance imbalance for both unmeasured and measured variables despite random assignment. Because receipt of services was not the main focus of the parent study, another

important limitation stems from the use a crude service utilization measure, prohibiting insight into important facets of the impact of receipt of additional services, such as the specific nature/type of services received, “dose” (e.g., number of supplemental service sessions received), and/or temporal considerations of the receipt of services. Similar concerns can be levied against the use of dichotomous drug use outcome variables in this study. Nevertheless, despite concerns about lack of sensitivity due to potentially crude measures, we note that the service measure used in this study did have predictive power with respect to outcome variables of interest, and a dichotomous drug use outcome variable corresponds to a clinically meaningful goal of abstinence. Finally, also due to the focus of the parent study, results can only be generalized to men on methadone in heterosexual relationships, which represented about half of the randomly selected men who participated in the screening phase for the parent study.

4.2 Lessons Learned

The aforementioned limitations and associated considerations notwithstanding, this study’s findings indicate that receipt of additional medical and/or psychosocial services is beneficial to treatment outcomes focused on abstinence from illicit drug use. These findings also support and reinforce efforts for drug treatment service providers to address health and psychosocial needs beyond addiction among their clients. We do not interpret these findings to mean that on-site provision of services can be replaced by off-site services, especially since earlier research demonstrates that a greater proportion of clients will receive services when they are provided on-site (Umbricht-Schneider et al., 1994). Rather, if provision of such services within the MMTP is not available or not possible, then methadone treatment service providers may still find it beneficial to assist patients in receiving such services outside of the MMTP.

Future evaluation and research endeavors should then be designed to collect and analyze data to address the following: What is the relative cost-effectiveness of on-site versus referral methods of meeting ancillary needs among drug treatment clients? If on-site provision is not possible, how can receipt of additional, off-site services be secured or increased? Which types of additional services or service providers are most helpful and for whom? Is there a minimum “threshold” (e.g., number of visits within a specific time period) for receipt of additional services before beneficial effects can be gained? What barriers are encountered when methadone patients are referred to off-site service providers?

The importance of these efforts are underscored given the high prevalence of service needs noted among this sample of men in methadone treatment, most of whom are either African American or Latino. The adverse health conditions (e.g., HIV) prevalent among MMTP patients are some of the same targets of current federal initiatives designed to eliminate or reduce health disparities that exist among specific population groups in the United States (National Institutes of Health, 2001; U.S. Department of Health and Human Services, 2000), including racial/ethnic minorities as well as disadvantaged socioeconomic groups (e.g., those without health insurance and/or unemployed). Thus, not only would efforts to increase supplemental services be likely to improve drug treatment outcomes among methadone treatment patients, such efforts may represent a valuable venue to address better the public health system’s goal of reducing or eliminating health disparities in urban settings.

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References

- Aszalos R, McDuff DR, Weintraub E, Montoya I, Schwartz R. Engaging hospitalized heroin-dependent patients into substance abuse treatment. *Journal of Substance Abuse Treatment* 1999;17(1–2):149–158. [PubMed: 10435263]
- Ball, JC.; Ross, A. The effectiveness of methadone maintenance treatment: Patients, programs, services, and outcome. New York, NY: Springer-Verlag; 1991. Prevalence and change in psychiatric symptomatology among methadone maintenance patients; p. 188-194.
- Barnett PG, Hui SS. The cost-effectiveness of methadone maintenance. *Mount Sinai Journal of Medicine* 2000;67(5 & 6):365–374. [PubMed: 11064486]
- Broome KM, Simpson DD, Joe GW. Patient and program attributes related to treatment process indicators in DATOS. *Drug & Alcohol Dependence* 1999;57(2):127–135. [PubMed: 10617097]
- Brooner RK, King VL, Kidorf M, Schmidt CW, Bigelow GE. Psychiatric and substance use comorbidity among treatment-seeking opioid users. *Archives of General Psychiatry* 1997;54(1):71–80. [PubMed: 9006403]
- Calsyn DA, Wells EA, Fleming C, Saxon AJ. Changes in Millon Clinical Multiaxial Inventory scores among opiate addicts as a function of retention in methadone maintenance treatment and recent drug use. *American Journal of Drug and Alcohol Abuse* 2000;26(2):297–309. [PubMed: 10852362]
- Darke S. Self-report among injecting drug users: A review. *Drug & Alcohol Dependence* 1998;51(3):253–263. [PubMed: 9787998]
- Dehejia, RH.; Wahba, S. Propensity score matching methods for non-experimental causal studies (No. Working Paper 6829). Cambridge, MA: National Bureau of Economic Research; 1998.
- Dehejia RH, Wahba S. Causal effects in non-experimental studies: Re-evaluating the evaluation of training programs. *Journal of the American Statistical Association* 1999;94(448):1053–1062.
- Derogatis, LR. Brief Symptom Inventory: Administration, scoring, and procedures manual. Minneapolis, MN: National Computer Systems, Inc; 1993.
- El-Bassel N, Fontdevila J, Gilbert L, Voisin D, Richman BL, Pitchell P. HIV risks of men in methadone maintenance treatment programs who abuse their intimate partners: A forgotten issue. *Journal of Substance Abuse* 2001;13(1–2):1–15. [PubMed: 11547611]
- El-Bassel N, Gilbert L, Schilling R, Wada T. Drug abuse and partner violence among women in methadone treatment. *Journal of Family Violence* 2000;15(3):209–228.
- Etheridge RM, Hubbard RL, Anderson J, Craddock SG, Flynn PM. Treatment structure and program services in the Drug Abuse Treatment Outcome Study (DATOS). *Psychology of Addictive Behaviors* 1997;11(4):244–260.
- Foa EB. *Posttraumatic Stress Diagnostic Scale Manual*. 1995
- Friedmann PD, Alexander JA, Jin L, D’Aunno TA. On-site primary care and mental health services in outpatient drug abuse treatment units. *Journal of Behavioral Health Services & Research* 1999;26(1):80–94. [PubMed: 10069143]
- Gearing FR, Schweitzer MD. An epidemiological evaluation of long-term methadone maintenance treatment for heroin addiction. *American Journal of Epidemiology* 1974;100(2):101–112. [PubMed: 4850534]
- Hagen J, Des Jarlais DC. HIV and HCV infection among injecting drug users. *Mount Sinai Journal of Medicine* 2000;37(5 & 6):423–428.
- Hser YI, Maglione M, Boyle K. Validity of self-report of drug use among STD patients, ER patients, and arrestees. *American Journal of Drug & Alcohol Abuse* 1999;25(1):81–91. [PubMed: 10078979]
- Institute of Medicine. *Federal regulation of methadone treatment*. Washington DC: National Academy Press; 1995.
- Joe GW, Simpson DD, Hubbard RL. Treatment predictors of tenure in methadone maintenance. *Journal of Substance Abuse* 1991;3(1):73–84. [PubMed: 1821275]
- Joe GW, Simpson DD, Sells SB. Treatment process and relapse to opioid use during methadone maintenance. *Journal of Drug and Alcohol Abuse* 1994;20(2):173–197.
- Johnson ME, Fisher DG, Montoya I, Booth R, Rhodes F, Andersen M, et al. Reliability and validity of not-in-treatment drug users’ follow-up self-reports. *AIDS & Behavior* 2000;4(4):373–380.

- Joseph H, Stancliff S, Langrod J. Methadone maintenance treatment (MMT): A review of historical and clinical issues. *Mount Sinai Journal of Medicine* 2000;67(5 & 6):347–364. [PubMed: 11064485]
- Kraft MK, Rothbard AB, Hadley TR, McLellan AT, Asch DA. Are supplementary services provided during methadone maintenance really cost-effective? *American Journal of Psychiatry* 1997;154(9):1214–1219. [PubMed: 9286179]
- Little, RJA.; Rubin, DB. *Statistical Analysis with Missing Data*. Hoboken, NJ: John Wiley & Sons, Inc; 2002.
- Marsh JC, Cao D, D’Aunno T. Gender differences in the impact of comprehensive services in substance abuse treatment. *Journal of Substance Abuse Treatment* 2004;27(4):289–300. [PubMed: 15610830]
- Marsh JC, D’Aunno TA, Smith BD. Increasing access and providing social services to improve drug abuse treatment for women with children. *Addiction* 2000;95(8):1237–1247. [PubMed: 11092071]
- McLellan, AT. Patient characteristics associated with outcome. In: Cooper, JR.; Altman, F.; Brown, BS.; Czechowicz, D., editors. *Research on the treatment of narcotic addiction: State of the art*. Rockville, MD: U.S. Government Printing Office; 1983.
- McLellan AT, Grissom GR, Brill P, Durell J, Metzger DS, O’Brien CP. The effects of psychosocial services in substance abuse treatment. *JAMA* 1993;269(15):1953–1959. [PubMed: 8385230]
- McLellan AT, Hagan TA, Levine M, Gould F, Meyers K, Bencivengo M, et al. Supplemental social services improve outcomes in public addiction treatment. *Addiction* 1998;93(10):1489–1499. [PubMed: 9926553]
- Milby JB, Sims MK, Khuder S, Schumacher JE, Huggins N, McLellan AT, et al. Psychiatric comorbidity: Prevalence in methadone maintenance treatment. *American Journal of Drug and Alcohol Abuse* 1996;22(1):95–107. [PubMed: 8651147]
- National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction. *Effective medical treatment of opiate addiction*. *JAMA* 1998;280(22):1936–1943. [PubMed: 9851480]
- National Institutes of Health. *NIH Strategic Research Plan to Reduce and Ultimately Eliminate Health Disparities*. Rockville, MD: National Institutes of Health; 2001.
- Novick DM. The impact of hepatitis C virus infection on methadone maintenance treatment. *Mount Sinai Journal of Medicine* 2000;67(5 & 6):437–443. [PubMed: 11064495]
- Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. *Biometrika* 1983;70(1):41–55.
- Rosenbaum PR, Rubin DB. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician* 1985;39(1):33–38.
- Royston P. Multiple imputation of missing values. *The Stata Journal* 2004;4(2):227–241.
- Rubin, D. *Multiple imputation for nonresponse in surveys*. New York, NY: John Wiley & Sons, Inc; 1987.
- Rubin DB. Using multivariate matched sampling and regression adjustment to control bias in observational studies. *Journal of the American Statistical Association* 1979;74(366):318–328.
- Saxon AJ, Wells EA, Fleming C, Jackson R, Calsyn DA. Pre-treatment characteristics, program philosophy and level of ancillary services as predictors of methadone maintenance treatment outcome. *Addiction* 1996;91(8):1197–1209. [PubMed: 8828247]
- Schiff M, El-Bassel N, Engstrom M, Gilbert L. Psychological distress and intimate physical and sexual abuse among women in methadone maintenance treatment programs. *Social Service Review* 2002;76(2):302–320.
- Shafer, JL. *Analysis of Incomplete Multivariate Data*. London: Chapman & Hall; 1997.
- Shepard DS, Larson MJ, Hoffmann NG. Cost-effectiveness of substance abuse services. Implications for public policy. *Psychiatric Clinics of North America* 1999;22(2):385–400. [PubMed: 10385940]
- Simpson DD, Joe GW, Broome KM, Hiller ML, Knight K, Rowan-Szal GA. Program diversity and treatment retention rates in the Drug Abuse Treatment Outcome Study (DATOS). *Psychology of Addictive Behaviors* 1997;11(4):279–293.
- Smith BD, Marsh JC. Client-service matching in substance abuse treatment for women with children. *Journal of Substance Abuse Treatment* 2002;22(3):161–168. [PubMed: 12039620]

- Substance Abuse and Mental Health Services Administration. Results from the 2002 National Survey on Drug Use and Health: National findings (No. DHHS Publication No. SMA 03–3836). Rockville, MD: Substance Abuse and Mental Health Services Administration; 2003.
- Substance Abuse and Mental Health Services Administration. Results from the 2003 National Survey on Drug Use and Health: National findings (No. DHHS Publication No. SMA 04–3964). Rockville, MD: Substance Abuse and Mental Health Services Administration; 2004.
- Substance Abuse and Mental Health Services Administration. Results from the 2006 National Survey on Drug Use and Health: National findings (No. DHHS Publication No. SMA 07–4293). Rockville, MD: Substance Abuse and Mental Health Services Administration; 2007.
- U.S. Department of Health and Human Services. Healthy People 2010: Understanding and improving health. Washington, DC: U.S. Government Printing Office; 2000.
- Umbricht-Schneiter A, Ginn DH, Pabst KM, Bigelow GE. Providing medical care to methadone clinic patients: Referral vs on-site care. *American Journal of Public Health* 1994;84(2):207–210. [PubMed: 8296941]
- van Buuren S, Boshuizen HC, Knook DL. Multiple imputation of missing blood pressure covariates in survival analysis. *Statistics in Medicine* 1999;18(6):681–694. [PubMed: 10204197]
- Wasserman DA, Korcha R, Havassy BE, Hall SM. Factors associated with lapses to heroin use during methadone maintenance. *Drug and Alcohol Dependence* 1998;52(3):183–192. [PubMed: 9839144]
- Weichselbaumer D, Winter-Ebmer R. A meta-analysis of the international gender wage gap. *Journal of Economic Surveys* 2005;19(3):479–511.
- Widman M, Platt JJ, Lidz V, Mathis DA, Metzger DS. Patterns of service use and treatment involvement of methadone maintenance patients. *Journal of Substance Abuse Treatment* 1997;14(1):29–35. [PubMed: 9218234]
- Woody GE, Luborsky L, McLellan AT, O'Brien CP, Beck AT, Blaine J, et al. Psychotherapy for opiate addicts: Does it help? *Archives of General Psychiatry* 1983;40(6):639–645. [PubMed: 6847332]
- Woody GE, McLellan AT, Luborsky L, O'Brien CP. Psychotherapy in community methadone programs: A validation study. *American Journal of Psychiatry* 1995;152(9):1302–1308. [PubMed: 7653685]

Biographies

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Louisa Gilbert is the Co-Director of SIG. In addition to advancing the gamut of research conducted at SIG, her research interests center on the health and well-being of women dealing with the co-occurrence of substance abuse, violence, and HIV risk.

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Glorice Sanders is on staff at the Beth Israel Medical Center, where she has provided guidance and oversight in several behavioral epidemiological and intervention research studies.

Table 1

Overview of the study sample, for the total sample as well as by those who received or did not receive additional off-site services; descriptive statistics are mean (and standard deviation, *SD*) for continuous variables and number (and proportion) for categorical variables.

Variable	<u>Total sample (N = 356)</u>	<u>Recipients (N = 105)</u>	<u>Non-recipients (N = 251)</u>
	\bar{x} (<i>SD</i>)	\bar{x} (<i>SD</i>)	\bar{x} (<i>SD</i>)
Age (yrs.)	43.6 (8.5)	43.3 (7.5)	43.8 (9.0)
Yrs. of education	11.6 (2.3)	12.0 (2.3)*	11.5 (2.3)*
Income (\$/mo.)	989.2 (957.9)	1066.7 (1143.1)	956.8 (869.4)
Methadone treatment duration (yrs.)	8.3 (7.4)	8.9 (7.6)	8.1 (7.3)
Methadone dose (mg)	84.4 (30.8)	83.5 (29.4)	84.7 (31.3)
SLEC score	1.1 (1.5)	1.8 (2.0)**	0.8 (1.1)**
BSI Global Severity Index	0.6 (0.6)	0.9 (0.7)**	0.5 (0.6)**
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Race/ethnicity			
African American	134 (38%)	37 (35%)	97 (39%)
Latino	161 (45%)	44 (42%)	117 (47%)
White/other	61 (17%)	24 (23%)	37 (15%)
Employed	187 (53%)	59 (56%)	128 (51%)
Had health insurance	285 (80%)	90 (86%)	195 (78%)
Marital status			
Single, never married	158 (44%)	46 (44%)	112 (45%)
Divorced/separated/widowed	101 (28%)	33 (31%)	68 (27%)
Married	97 (27%)	26 (25%)	71 (28%)
HIV status			
Negative	269 (76%)	76 (72%)	193 (77%)
Unknown	36 (10%)	6 (6%)	30 (12%)
Positive	51 (14%)	23 (22%)**	28 (11%)**

* $p < .05$,

** $p < .01$ for differences within a row

Table 2

Illicit drug use versus time; estimates are proportion (and standard error, *SE*) of the following groups: the total sample ($N = 356$), recipients of additional off-site services ($N = 105$), and non-recipients of additional off-site services ($N = 251$).

Drug	Group	Months:		
		0 to 6 % (<i>SE</i>)	6 to 12 % (<i>SE</i>)	0 to 12 % (<i>SE</i>)
Cocaine	Total sample	33% (3%)	33% (3%)	31% (3%)
	Recipients	28% (4%)	25% (5%)	30% (5%)
	Non-recipients	36% (3%)	36% (4%)	32% (3%)
Crack	Total sample	19% (2%)	22% (2%)	20% (3%)
	Recipients	17% (4%)	25% (5%)	22% (5%)
	Non-recipients	20% (3%)	21% (3%)	19% (4%)
Heroin	Total sample	51% (3%)	55% (3%)	47% (3%)
	Recipients	41% (5%)	50% (5%)	42% (5%)
	Non-recipients	55% (3%)	57% (4%)	49% (4%)
Marijuana	Total sample	38% (3%)	36% (3%)	38% (4%)
	Recipients	37% (5%)	31% (5%)	32% (6%)
	Non-recipients	38% (3%)	38% (3%)	40% (4%)
Any illicit drug	Total sample	73% (2%)	75% (2%)	71% (3%)
	Recipients	66% (5%)	67% (5%)	62% (5%)
	Non-recipients	76% (3%)	79% (3%)	75% (3%)

Table 3

Effects of receiving additional off-site services on likelihood of abstaining from use of indicated drug among male MMTP patients; estimates are adjusted odds ratios (*ORs*) and 95% confidence intervals (95% *CI*s) after propensity score matching and covariance adjustment^a.

Drug	N	<u>After receiving additional off-site services, likelihood of abstaining from indicated drug during months:</u>		
		<u>0 to 6</u>	<u>6 to 12</u>	<u>0 to 12</u>
		<i>OR</i> [95% <i>CI</i>]	<i>OR</i> [95% <i>CI</i>]	<i>OR</i> [95% <i>CI</i>]
Cocaine	169	4.76 [1.85, 12.50]***	1.11 [0.41, 3.03]	2.86 [1.19, 7.14]*
Crack	173	1.10 [0.29, 4.17]	1.59 [0.55, 4.55]	1.56 [0.39, 6.25]
Heroin	172	3.57 [1.47, 9.09]**	1.96 [0.64, 5.88]	2.63 [1.14, 6.25]*
Marijuana	167	1.08 [0.43, 2.70]	1.85 [0.53, 6.67]	1.96 [0.52, 7.69]
Any illicit drug	168	3.45 [1.30, 9.09]*	3.13 [1.22, 8.33]*	3.85 [1.28, 11.11]*

*
p<.05,

**
p<.01,

p<.001

^aVariables used for propensity score matching and covariance adjustment include: age, race/ethnicity, years of formal education, current employment status, natural log of monthly income, currently having health insurance, marital status, duration of current methadone treatment, current methadone dose, HIV status, stressful life events (SLEC score), psychological distress (BSI Global Severity Index), and use of indicated drug at time of baseline assessment.