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Cost Analysis of Clinic and Office-based Treatment of Opioid Dependence: Results with Methadone and Buprenorphine in Clinically Stable Patients

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Abstract

The cost of providing and receiving treatment for opioid dependence can determine its adoption. To compare the cost of clinic-based methadone (MC, n=23), office-based methadone (MO, n=21), and office-based buprenorphine (BO, n=34) we performed an analysis of treatment and patient costs over 6 months of maintenance in patients who had previously been stabilized for at least one year. We performed statistical comparisons using ANOVA and chi-square tests and performed a sensitivity analysis varying cost estimates and intensity of clinical contact. The cost of providing one month of treatment per patient was $147 (MC), $220 (MO) and $336 (BO) ($p<0.001$). Mean monthly medication cost was $93 (MC), $86 (MO) and $257 (BO) ($p<0.001$). The cost to patients was $92 (MC), $63 (MO) and $38 (BO) ($p=0.102$). Sensitivity analyses, varying cost estimates and clinical contact, result in total monthly costs of $117 to $183 (MC), $149 to $279 (MO), $292 to $499(BO). Monthly patient costs were $84 to $133 (MC), $55 to $105 (MO) and $34 to $65 (BO). We conclude that providing clinic-based methadone is least expensive. The price of buprenorphine accounts for a major portion of the difference in costs. For patients, office-based treatment may be less expensive.

Keywords

Costs and cost analysis; opioid-related disorders; methadone; buprenorphine

1. Introduction

In 2000, it was estimated that heroin dependence cost the United States (U.S.) $21 billion per year. Drug treatment expenses accounted for 5.7% of the total cost. Medical care including drug treatment and complications such as AIDS (23%), lost productivity (52.6%), and crime (23.9%) accounted for the largest portions of these cost. (Mark et al., 2001) Annual costs for

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prescription opioid medication abuse in the U.S. are an estimated $4.6 billion in the workplace, $2.6 billion in health care, and $1.4 billion to the criminal justice system (Birnbaum et al., 2006).

Methadone maintenance has an incremental cost effectiveness ratio (ICER) of $5,915 per life-year gained (Barnett, 1999). In health care cost-effectiveness analyses, these values indicate that methadone maintenance treatment would be considered a good investment for society (Zaric et al., 2000). These studies understate the full benefits, if the reduction in crime and spread of disease were to be included, the societal benefits would be greater. One cost-effectiveness analysis found that expanded access to methadone maintenance had an ICER of less than $11,000 per quality-adjusted life year (QALY). (Barnett, 2000) Cost to benefit ratios for methadone have been reported at 1:4 to 1:18 (Cartwright, 2000, Harwood et al., 1988).

In the U.S., in 2005, 235,836 individuals received methadone for treatment of opioid dependence. This represented 22% of all treatment admissions for opioids (Anonymous, 2006) The use of methadone for maintenance treatment is primarily restricted to federally licensed clinics (opioid treatment programs, OTPs), and to a small number of office-based physicians with special dispensation (Fiellin and O'Connor, 2002). For the 3-year period between January 2003 and December 2006, approximately 300,000 patients were treated with buprenorphine and/or buprenorphine/naloxone (Fiellin, 2007).

Buprenorphine and methadone maintenance have similar efficacy, although some findings demonstrate greater retention and less illicit drug use with methadone (Amato et al., 2005). Prior cost and cost-effectiveness studies of maintenance with methadone compared to buprenorphine have produced mixed results, partly because studies use an array of parameter estimates (Simoens et al., 2006). The annual cost of providing methadone maintenance treatment in an outpatient setting ranges between $2,000 and $15,682 depending upon the level of services provided (Avants et al., 1999, Bradley et al., 1994, Roebuck et al., 2003, Rosenheck and Kosten, 2001, Harris et al., 2005, Doran et al., 2003, Zarkin et al., 2001). These costs are driven by regulatory (state and federal) requirements and guidelines from accreditation bodies (Center for Substance Abuse Treatment). These requirements result in a lower limit of costs that can increase based on a range of intensity of clinical contacts driven by such factors as the clinic's model of treatment and on patients' clinical status over time.

The Food and Drug Administration (FDA) approved two sublingual formulations of buprenorphine for the treatment of opioid dependence in 2002 (Fiellin et al., 2004). A waiver system enables physicians who have received eight hours of training in the treatment of opioid dependence to treat up to 100 opioid-dependent individuals in any setting in which they are licensed to practice (Substance Abuse and Mental Health Administration).

Cost is a potential barrier to the expansion of buprenorphine/naloxone. The monthly cost for buprenorphine/naloxone can be at least 10 times that for methadone (Anonymous, 2003). In fact, physicians who prescribe buprenorphine report cost as a challenge, most frequently, when asked about challenges to treatment (Substance Abuse and Mental Health Services Administration). Public and private funding programs variably include buprenorphine on the formulary. In addition, managed care programs contracted through Medicaid may have limited access to buprenorphine and the appropriate counseling services (Schackman et al., 2006). Thus, reimbursement for physician services, medication, and ancillary services can vary by state and insurance plan, leading to potentially restrictive out-of-pocket fees for patients and resistance by physicians (Clark, 2003).

Prior to the approval of buprenorphine for use in physician offices in the U.S. an economic model predicted that buprenorphine maintenance therapy would be similar (92% to 114%) to the cost of methadone maintenance in the first year and (81% to 97%) in subsequent years.

The model reflected decreased service use after one year of treatment due to clinical stability. The model predicted that, when the patient-related costs of receiving treatment were considered, the cost of buprenorphine would be lower than the cost of methadone in the first year (54% to 76%) and in subsequent years (44% to 64%). The authors predicted, however, that costs for buprenorphine could increase, in comparison to methadone, if socially stabilized patients (e.g. employed, married, fewer adverse effects from addiction) were attracted to buprenorphine (Rosenheck and Kosten, 2001).

Office-based treatment with methadone and buprenorphine are available in selected countries internationally (Fiellin and Strain, 2005). One advantage of physician office-based treatment is that patients with comorbid medical or psychiatric conditions (e.g. hepatitis or depression) can have these issues addressed by the same physicians who provide their substance abuse treatment. In the United States, treatment guidelines recommend socially stable, less medically and psychiatrically complex patients for office-based treatment with methadone or buprenorphine (Substance Abuse and Mental Health Services Administration, 2004, Substance Abuse and Mental Health Services Administration, 2007b). To date, there have been no reports that present the actual costs associated with providing buprenorphine treatment, compared to office or clinic-based methadone, in the U.S. based upon data obtained in patients receiving this treatment. In addition, there have been no reports that compare the cost incurred by patients receiving either methadone or buprenorphine in these settings. The purpose of the current study was to determine which treatment; clinic-based methadone, office-based methadone, or office-based buprenorphine was least expensive in clinically stable patients.

2. Methods

2.1. Overview

We performed an analysis of costs obtained in two prior evaluations of patients receiving three types of care; clinic-based methadone (MC), office-based methadone (MO), or office-based buprenorphine (BO). Data were collected during the conduct of a clinical trial (Fiellin et al., 2001) and an extension phase of an observational study (Fiellin et al., 2008). Our goal was to determine if MC, MO, or BO is least expensive from the perspective of treatment providers and patients.

2.2. Study Design and Patients

Patients receiving methadone were enrolled in a clinical trial assessing the relative effectiveness of maintenance in two settings: (1) office-based primary care settings, and (2) a federally licensed methadone clinic (Fiellin et al., 2001, Fiellin et al., 2006). Patients had been in treatment at the clinic for at least one year. Patients were between the ages of 18 and 60 years, had no urine toxicology screenings positive for illicit opioids or cocaine in the previous 12 months, had no significant psychiatric or medical condition, at the time of entry into the studies they had no evidence of dependence, via the Structured Clinical Interview for DSM Disorder, (American Psychiatric Association, 1994) on cocaine, alcohol or drugs other then opioids. Patients were required to have a legal income, consistent residence, transportation to and from the treatment site, anticipate continuing maintenance treatment for at least 12 months. Forty-seven patients were randomized to continue to receive methadone maintenance in the clinic (MC) (n=25) or to receive office-based methadone (MO) at a primary care physician's office (n=22). For the purposes of the cost analysis, we confined our analysis to the 44 patients who provided at least one urine sample for toxicology screening during the 6-month study period included in the current study. Data were collected between February 1999 and March 2000.

Patients receiving buprenorphine were enrolled in an observational cohort study of office-based buprenorphine (BO) maintenance therapy. Patients in this cohort were opioid dependent adults who had no evidence of psychosis, major depression, or a life-threatening medical problem, were able to understand English, and were not dependent upon alcohol, benzodiazepines, or sedatives. Women in the cohort agreed to use contraception and pregnancy monitoring. Patients included in this cost analysis had also demonstrated clinical stability, with infrequent opiate use (13% of 1022 urine samples positive for opiates), during the prior 12 month period. We included data from the 34 patients in the cohort who provided at least one urine sample for toxicology screening over a 6-month period. These data were collected between 2002 and 2005 (Fiellin et al., 2006).

Table 1 provides a summary of the eligibility and inclusion criteria and treatment protocols. MC patients received methadone from a clinic, thrice or once weekly as stipulated by federal regulations. For the MO and BO groups, physician visits included individual counseling and treatment recommendations. The brief sessions covered: recent drug use or efforts at abstinence, self-help group attendance, support for efforts to reduce drug use or remain abstinent, advice towards achieving or maintaining abstinence, review of urine specimen results and assessment of addiction-related employment, legal, family/social, medical or psychiatric problems. This type of counseling has demonstrated feasibility and effectiveness in office-based treatment (Alford et al., 2007,Fiellin et al., 2006,Stein et al., 2005) and is consistent with, if not more intensive, than what is currently provided in the United States (Fiellin, 2007).

This research was approved by the Yale University School of Medicine.

2.2. Data Collection

2.2.1. Urine toxicology data—For both the MC and MO group, urine samples were collected randomly, approximately monthly, and nonrandom urine samples for research assessments were also collected. For the BO group, urine samples were collected nonrandomly, approximately monthly at physician visits. To assure comparability, only the nonrandom samples for all three groups were used for our analysis.

2.2.2. Cost inputs

2.2.2.1. Income, transportation, childcare expenses (Table 2): The Addiction Severity Index (ASI) (McLellan et al., 1992a) and a Treatment Service Review (TSR) (McLellan et al., 1992b)were administered at baseline and every 12 weeks on all patients. The TSR covered the 12-week period since the last assessment and was modified to provide data regarding money spent on transportation and childcare.

2.2.2.2 Time dependent costs (Table 2): Data regarding time spent with clinicians, clinician type (physician, nurse, or counselor), wait time, and transportation time were collected from patients receiving methadone. For the MC group, medication dispensing time was not recorded and was estimated (1 minutes/ visit) retrospectively based upon the volume of patients seen per hour (60 patients per hour) per dispensing nurse at the clinic. For MO patients the time for nurse medication dispensing were recorded at each visit. For missing values of time spent with nurses or physicians, we assumed a 10-minute nursing visit and a 20-minute physician visit.

Time with physicians was recorded at each BO visit. Transportation time and wait times during the study period were not available so patients' report of these times, provided during their first 6 months of treatment (e.g. mean transportation and wait times per visit) was used. Time spent with nurses for medication dispensing was estimated based upon nurse self-report. Nurses

indicated that they spent approximately 20 minutes per month per patient dispensing medication and/or collecting urine samples for toxicology testing (2 visits of 10 minutes each).

2.2.3. Cost calculations—We determined the mean monthly cost of treatment per patient from the perspective of providers as well as receivers of treatment using a service level costing approach (Anderson et al., 1998). The service level costing approach has been used in the extant literature on cost effectiveness analysis in addiction evaluations and is suitable for use in clinical trials (Olmstead et al., 2007, Sindelar et al., 2007, Sindelar et al., 2007). Only data from patients who remained in treatment for the 6-month study period were included in order to determine actual costs.

2.2.3.1. Costs of providing treatment: The cost of providing treatment included personnel costs, medication and laboratory costs, overhead and administrative costs for all treatment groups. To determine personnel cost, we multiplied physician, nurse, and counselor time by the hourly wage including fringe benefits. Nurse and counselor salaries including fringe benefits, toxicology screening cost, and medication cost were collected from the methadone clinic in 2006 dollar amounts. Physician salary and fringe was calculated using the local mean hourly wage for internal medicine physicians in 2006, $72.74 per hour, plus the Bureau of Labor Statistics 2005 estimate of 30% as the fringe rate for health care professionals (U.S. Department of Labor Bureau of Labor Statistics, 2007b). An adjustment for clinician time and overhead costs was added based upon the percentage of missed visits in each treatment group (MC: 4%, MO: 15%, BO: 22%).

Medication costs were calculated using the clinic's price paid per milligram of methadone and of buprenorphine, multiplied by the total milligrams prescribed to each patient during the 6-month study period. Urine toxicology cost ($25) was calculated using a local physician's office cost per toxicology screening multiplied by the number of toxicology tests per patient for the study period. The administrative and overhead costs for the opioid treatment program were obtained directly from the annual operating statement provided by the program. For the office-based treatments, an overhead rate was calculated based upon Centers for Medicare and Medicaid Services data regarding physician office visit reimbursement and the ratio of practice expenses to clinician compensation and fringe benefits (Medicare Payment Advisory Commission). The numerator was the cost of rent, insurance, administrative costs, and supplies. The denominator was the summation of clinician wages and fringe. As both calculations resulted in an overhead rate of approximately 46% this value was used for all treatment groups. This rate was then applied to physician, nursing, and counseling costs.

2.2.3.2. Cost of receiving treatment: The cost of receiving treatment included the mutually exclusive patient-reported costs associated with transportation and childcare as well as the cost of their time spent getting back and forth to visits, waiting for clinicians, and time spent with clinicians. Since these were not specifically health care related, they were adjusted to 2006 dollar amounts using the standard consumer price index (U.S. Department of Labor Bureau of Labor Statistics, 2007). The cost of the patients' time was estimated using the local minimum wage ($7.40 per hour) (State of Connecticut Department of Labor). All income information was adjusted to 2006 dollars.

2.3. Data Analysis

The primary outcome was the mean monthly cost of treatment per patient. This outcome included the cost of providing treatment and the cost to patients of receiving treatment. Continuous variables were compared using ANOVA and chi-square test for categorical variables. Post hoc pair comparisons used the Bonferroni adjustment. Monthly income was

adjusted to 2006 dollars using consumer price index conversion factors for the years in which the data were collected (U.S. Department of Labor Bureau of Labor Statistics, 2007).

Using analysis of variance (ANOVA), we compared the percentage of patients retained in treatment for six months, the mean percentage of illicit opioid-free urine samples, and the mean percentage of cocaine-free urine samples. For each patient, the percentage of opioid and cocaine-free urine samples was a percentage of the total urine samples provided by the patient. Missing samples were not considered. The percentage of patients retained in treatment for six months was evaluated using chi-square analysis.

All statistical analyses were completed using SPSS version 14.0 and Microsoft Office Excel 2003. All statistical comparisons were performed two-tailed with $p < 0.05$ considered significant.

2.3.1. Sensitivity Analysis—In order to evaluate the sensitivity of our results to different cost estimates and different clinical contexts, we performed a 2-part sensitivity analysis. First, we calculated high and low estimates for mean cost per month of treatment per patient in the three groups based upon variable unit cost estimates, systematically manipulating clinician salaries, medication prices, urine toxicology testing, and patient wage. Data from 2005 regarding mean wage for clinicians in the top paying states and lowest paying state were used to determine wage rates. A 30% fringe benefit was included (U.S. Department of Labor Bureau of Labor Statistics, 2007). The cost of methadone was not altered as its use is restricted to federally licensed facilities and is available as a generic medication; therefore, the price is unlikely to differ. The cost of buprenorphine paid by a local clinic (low price) and the price of 8-mg tablets at an on-line national discount retailer (high price) were used to estimate its cost. In addition, high and low price estimates were obtained assuming that doses were provided in 8-mg tablets (low estimate) or 2-mg tablets (high estimate). Urine toxicology price was based upon the lowest price found for a FDA-approved onsite urine test, and the highest price was the one used in the primary analysis. The range of overhead rates came from previously published reports from outpatient methadone maintenance programs (Avants et al., 1999, Bradley et al., 1994, Roebuck et al., 2003, Rosenheck and Kosten, 2001). We varied the wage from the federal minimum wage to the mean national wage in 2006.

The second part of the sensitivity analysis investigated the impact of changes to the treatment. We considered the study treatment protocols to be the lowest intensity of services. Then we simulated a more intensive treatment comparable to early or enhanced treatment. For the MC group, we included an initial one-hour physician visit, a five times-weekly 1-minute nursing visits for medication dispensing and weekly group counseling and monthly one-hour counseling visits. Medication dosages remained the same in all groups and the local minimum wage ($7.40 per hour) was used to value time. For the MO and BO groups, we simulated a scenario of a one-hour initial physician visit, monthly 20-minute physician visits, thrice weekly 20-minute nursing visits for medication dispensing and counseling for two weeks, followed by weekly visits for the remaining six months. We assumed weekly urine toxicology testing in all groups. Transportation costs, child care costs, and wait time for physician appointments were based on mean reported values.

3. Results

3.1. Demographic and Clinical Characteristics

Demographic and clinical characteristics of the patients are displayed in Table 3. The MC group was more likely to be white and had a lower proportion of HIV-positive patients as compared to the MO group. The BO group was younger, less likely to have a history of intravenous drug use, reported fewer years of regular opioid use, and had a higher monthly

income at baseline than the MC group. Compared to the MO group, the BO group was younger, had a smaller proportion of patients who were known to be HIV-positive, and had a higher monthly income.

3.2. Cost (Table 4)

The cost per patient per month of providing treatment was $147 (MC), $220 (MO) and $336 (BO) ($p<0.001$, Table 4). Medication costs accounted for 63% (MC), 39% (MO), and 77% (BO).

The cost per patient per month of receiving treatment was $92 (MC), $63 (MO) and $39 (BO) ($p=0.102$, Table 4). Time costs accounted for 30% (MC), 43% (MO), and 44% (BO) of the overall patient costs whereas transportation costs accounted for 71% (MC), 53% (MO), and 55% (BO) of the overall patient costs.

The total cost of treatment, the sum of the cost of providing and receiving treatment, was $240 (MC), $275 (MO), and $378 (BO) per patient per month ($p<0.001$, Table 4).

3.3. Sensitivity Analysis (Table 5)

Sensitivity analysis of the change in unit cost values for clinician salaries, medication prices, urine toxicology testing, and patient wage demonstrated that the range of costs per patient per month of providing treatment was $117 to $183 (MC), $149 to $279 (MO) and $292 to $499 (BO). Patient-related costs, per patient per month, varied from $84 to $133 (MC), $55 to $105 (MO), and $34 to $65 (BO) depending upon the estimated hourly wage (federal minimum wage versus mean national wage in 2006).

Holding wages constant at the local minimum wage, we conducted a sensitivity analysis of high-intensity treatment, approximating care during treatment initiation or clinical instability (e.g. relapse). The total cost per patient per month of higher-intensity treatment is $632 (MC), $446 (MO) and $724 (BO). Provider-related costs are lower in MC versus BO ($378 versus $631), but patient costs are higher ($254 versus $93). MO is less expensive than either MC or BO at the higher level of intensity of treatment.

3.4 Treatment outcomes (Table 6)

We were unable to detect any differences is treatment outcomes as measured by treatment retention or percent of urine toxicology results that were free of opioids, cocaine, benzodiazepines or any of these three substances.

4. Discussion

Our results, obtained in patients who had been stabilized for at least one year, demonstrate that methadone maintenance treatment in a clinic-based setting is less expensive than office-based treatment with methadone or buprenorphine. Our results also demonstrate that benefits, as measured by abstinence rates, were similar. The difference in cost is due to the costs of buprenorphine among other factors. The distribution of the costs across treatment and patient as well as differences across cost categories within treatment provide insights. To our knowledge, this is the first such analysis to parse out the types of costs for buprenorphine and methadone by treatment location using data obtained on patients as they receive these three types of treatment for opioid dependence. Because the cost of buprenorphine/naloxone was a major determinant of the cost of office-based buprenorphine treatment, this component would be expected to change over time if prices were to decrease over time. We find that the cost to the patient of receiving treatment was highest with clinic-based methadone and lowest with office-based buprenorphine, although this difference did not reach statistical significance. The

value placed on patient time, which is likely to differ based on patient factors such as employment and wage, also affects the full cost of treatment. During a period of more intensive clinical contact such as at initiation of treatment or relapse, methadone maintenance is less expensive compared to buprenorphine, but when patient costs are included, the total cost of office-based treatments are lower.

The distribution of costs across treatment and patient will have implications for services used. If fees are paid by insurance or entitlements, it is likely that office-based treatment, which requires less patient time, will be more desirable from the patient perspective. This would be particularly true for those with a high value of time at work or at home. The option of office-based treatment may draw new individuals into treatment. Payers can affect utilization across these types of treatment depending on how generously they cover each.

The cost of providing treatment to the MC group ($1764) was lower than most estimates of $2,000 to $6,500 annually for methadone maintenance, but the cost was dynamic in our sensitivity analysis (Avants et al., 1999, Roebuck et al., 2003, Rosenheck and Kosten, 2001). This likely reflects the clinical stability of these patients as all had participated in treatment for at least one year and qualified for once to thrice weekly methadone medication visits therefore requiring few counseling or physician visits. Though the cost of initiating treatment and treating patients during an earlier phase of treatment are not included in the primary analysis, these costs were estimated in the sensitivity analysis. Sensitivity analysis results of provider costs at $2196 annually under a higher-intensity is in the range of published reports.

In the primary analysis, the cost of providing office-based buprenorphine ($4032) was consistent with a previous hypothetical estimated that predicted an annual cost between $2,261 and $4,843 per patient (Rosenheck and Kosten, 2001). In that model, developed prior to the introduction and marketing of buprenorphine in the U.S., the price of buprenorphine was assumed to range between $4 and $8 per 12 mg dose. Similarly, a separate cost-effectiveness model based on the assumption that a daily dose of buprenorphine/ naloxone would cost $5 predicted an annual treatment cost of $5,733 (Barnett et al., 2001). In fact, the actual mean daily dose for patients in our study was approximately 16 mg at an estimated cost of $8.58 per day. Capital and administrative costs in one of these prior models were estimated to be between 7% and 11%, substantially less than our calculation based upon the ratio of indirect costs to direct labor costs at the study methadone clinic (Rosenheck and Kosten, 2001). Our results, based upon actual clinical experience, validate previous predictions of the cost of providing office-based buprenorphine treatment.

Our study has limitations. The baseline demographic and clinical characteristics between the treatment groups differed. Demographic and clinical characteristics may affect the cost of providing care as different groups are likely to require different levels of clinical contact and ancillary services. To account for the impact of these characteristics on cost we conducted a sensitivity analysis to systematically manipulate unit costs, wages, and level of ancillary services. The sensitivity analysis is not able, however, to adjust for all potential clinical and demographic differences between the samples. The sizes of our patient samples may limit the generalizability of our findings. Cost estimates for methadone and buprenorphine/naloxone may change over time and vary by locale. Therefore similar analysis should be periodically repeated and take into consideration local costs. Although our data collection spanned six years, costs were all presented in 2006 dollars. Our analysis assumed that patients did not incur costs for the medication. Patients will likely bear some cost burden for medications under various entitlement and insurance scenarios. In addition, since we used service level costing approach, we were not able to capture costs for personnel that did not involved face-to-face contact with patients. Finally, certain clinical services such as medication dispensing from office-based settings as seen in the MO and BO conditions are not frequent in practice and may overestimate

nursing time. In practice, pharmacy dispensing is much more common. However, the times allotted for medication dispensing in the current analysis are similar to nursing time that would be spent collecting a urine sample and providing a patient with a pre-written prescription as is a more common scenario in clinical practice. We believe the sensitivity analysis that systematically evaluates potential deviation from our actual findings based on time should help account for potential variability in clinical samples and situations, although future work is needed in more diverse patients, especially those who have not yet achieved clinical stability.

In contrast to concerns about external validity, the internal validity of our findings, based on actual costs of providing and receiving treatments, resulting from detailed assessments or informed estimates from the patients and delivery systems, is a unique strength of the current investigation. Larger studies should be conducted to validate our findings. Patient income and the value of their time are likely to affect the cost of treatment. In our analysis we controlled for the baseline differences in wage by using a standard minimum wage. Transportation costs differed between groups likely because BO patients may have traveled further for fewer visits while MC patients made frequent short trips but still incurred parking and public transportation fees resulting in a larger cost per hour. Finally, these findings were obtained under the regulations for these medications that exist in the United States. Other countries with different regulations and cost may obtain different results.

That societal benefit from treatment for opioid dependence is well established (Anonymous, 1998). We have demonstrated that in the U.S., using current costs, office-based treatment with buprenorphine is more expensive than methadone maintenance treatment. As buprenorphine and methadone maintenance have similar efficacy, with some studies indicating greater retention and less illicit drug use with methadone, it might be suggested that methadone maintenance would be most cost effective at this time. The choice, however, is not this straightforward, as patients decide to enter treatment based on the availability of a treatments and the cost from their perspective, which includes time costs as well as out of pocket costs. While we realize that patients may choose treatments that are not optimal for their clinical condition, we also acknowledge that entry into treatment is the first step in a process and that treatments must appear acceptable at a variety of levels in order to engage them in appropriate clinical care. Early studies on entry into buprenorphine treatment (Sullivan et al., 2005) and the evaluation of the buprenorphine waiver program in the U.S. indicate that many patients receiving office-based buprenorphine are new to medication-assisted treatment and would require a treatment at a level similar to the high-intensity scenario in our sensitivity analysis (Substance Abuse and Mental Health Services Administration, 2007). Thus, cost and acceptability to patients will be an important determinant of treatment uptake. If the benefits to society of office-based buprenorphine outweighs its costs, than it may be a superior option simply because it is a more pragmatic approach to expanding treatment. Whether office-based treatment with buprenorphine expands, however, will depend upon who pays, how much they pay, and who decides. Providers now have the option to limit their practice and only accept patients whose care requirements (e.g. counseling, comorbidity) are suited to the resources that they can provide and for which they can receive reimbursement. This may mean that patients requiring higher intensity services, perhaps higher than that included in our sensitivity analysis would be referred to opioid treatment programs. Therefore, a valuable area for future work will be not the relative cost-effectiveness of these two treatment strategies but rather policy modifications that make both more available, thus providing options for patients seeking a treatment modality that they find acceptable and providers find appropriate.

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Table 1

Comparison of study populations and treatment protocols in patients receiving clinic-based methadone (MC), office-based methadone (MO) or buprenorphine (BO)

	Methadone		Buprenorphine
	MC n=23	**MO N=21**	**BO n=34**
Eligibility Criteria	Men and non-pregnant women ages 18-60 with opioid dependence	Same	Same
Inclusion Criteria	Provided at least one urine sample	Same	Same
Treatment History	Twelve months of methadone	Twelve months of methadone	Twelve months of buprenorphine
Counselor/physician Visit Frequency	Monthly counselor visits	Monthly physician visits	Monthly physician visits
Medication Pick-up	1x/week-3x/week	1x/week	Every 2 weeks
Counseling and other ancillary services	Onsite	Onsite	Onsite
Urine toxicology screening	Monthly	Monthly	Monthly
Daily medication dose, mg, mean (range)	69 (20-100)	70 (25-100)	16.7 (6-24)

Table 2

Cost inputs, sources, and unit costs utilized in the primary analysis comparing the cost of clinic-based methadone (MC), office-based methadone (MO) or buprenorphine (BO)

Cost Inputs	Sources	Unit Cost
Provider Related Costs		
Physician Time (wage and fringe)	Bureau of Labor Statistics	$94.56 per hour
Nurse Time (wage and fringe)	Opioid Treatment Program	$28.08 per hour
Counselor time (wage and fringe)	Opioid Treatment Program	$25.32 per hour
Overhead	Opioid Treatment Program	46% of clinician time
Adjustment for Missed Visits	Study Data	MC: 4%, MO:15%, BO: 22%, percentage of clinician and overhead cost
Medication	Opioid Treatment Program	Methadone: $0.05 per mg Buprenorphine: $0.53 per mg
Laboratory	Opioid Treatment Program	$25 per unit
Patient Related Costs		
Patient Time	Local minimum wage	$7.40 per hour
Child Care	Treatment Services Review	As reported
Transport	Treatment Services Review	As reported

Table 3

Baseline characteristics of patients receiving clinic-based methadone (MC), office-based methadone (MO) or buprenorphine (BO)

	Methadone		Buprenorphine	
	MC n=23	**MO n=21**	**BO n=34**	**P-value**
Mean age in years (SD)	41.0 (5.9)[C]	42.8 (5.6)[C]	35.6 (8.9)[A,B]	.001
White, % (n)	95.7 (22)[B]	61.9 (13)[A]	85.3 (29)	.01
Male, % (n)	65.2 (15)	61.9 (13)	85.3 (29)	.10
Never married, % (n)	39.1 (9)	38.1 (8)	58.8 (20)	.21
High school degree, % (n)	87.0 (20)	85.7 (18)	88.2 (30)	.96
Fully Employed, % (n)	78.3 (18)	57.1 (12)	52.9 (18)	.14
Lifetime IVDU, % (n)	87.0 (20)[C]	57.1 (12)	29.4 (10)[A]	<.001
Known HIV+, % (n)	4.3 (1)[B]	28.6 (6)[A,C]	2.9 (1)[B]	.005
Prior Detoxification, % (n)	100 (23)	81.0 (17)	76.5 (26)	.047
Prior Opioid Agonist Treatment, % (n)	52% (12)	67% (14)	41% (14)	.18
Mean Years Regular Opioid Use (SD)	15.2 (9.3)[C]	12.0 (5.2)	7.7 (6.4)[A]	.001
Mean Monthly Income (legal) in 2006 dollars (SD)	1,192 (1167) [C]	1,375 (1176) [C]	2,537 (2443) [A, B]	.02
Mean days worked in previous month (SD)	13.8 (10.2)	18.0 (11.2)	20.2 (8.2)	.07

[A]Denotes a statistically significant difference from the MC group in post hoc testing

[B]Denotes a statistically significant difference from the MO group in post hoc testing

[C]Denotes a statistically significant difference from the BO group in post hoc testing

[D]Includes periods of treatment with methadone or buprenorphine

IVDU: intravenous drug use

HIV+: known positive for the human immunodeficiency virus

Table 4

Total cost and office-based buprenorphine (BO) per patient per month in 2006 dollars

	Methadone				Buprenorphine		
	MC		MO		BO		
	Mean/patient	Cost, $	Mean / patient	Cost, $	Mean/patient	Cost, $	P-value
Provider-related costs							
Physician Time, hours, mean (SD)	0.00 (0.00) ^{B,C}	0 (0.00) ^{B,C}	0.55 (0.20) ^{A,C}	52.06 (19.21) ^{A,C}	0.25 (0.07) ^{A,B}	23.88 (6.65) ^{A,B}	<0.001
Nursing Time, hours, mean (SD)	0.07 (0.01) ^{B,C}	1.95 (0.18) ^{B,C}	0.48 (0.12) ^{A,C}	13.54 (3.47) ^{A,C}	0.33 (0.0) ^{A,B}	9.36 (0.00) ^{A,B}	<0.001
Counseling Time, hours, mean (SD)	0.77 (0.48) ^{B,C}	19.39 (12.18) ^{B,C}	0.05 (0.07) ^{A}	1.20 (1.78) ^{A}	0.00 (0.0) ^{A}	0.00 (0.00) ^{A}	<0.001
Subtotal: Clinician Time, hours, mean (SD)		21.34 (12.16) ^{C,B}		66.81 (21.08) ^{A,C}		33.24 (6.65) ^{A,B}	<0.001
Overhead/Administrative, mean (SD)		9.82 (5.60) ^{C,B}		30.73 (9.70) ^{A,C}		15.29 (3.06) ^{A,B}	<0.001
Adjustment for missed Visits		1.24 (.71) ^{C,B}		10.68 (2.13) ^{A,C}		14.63 (4.62) ^{A,B}	<0.001
Medication Cost , mean (SD)	1857.46 (551.06)	92.87 (27.55) ^{C}	1722.82 (686.80)	86.14 (34.34) ^{C}	485.50 (103.57)	257.32 (54.89) ^{A,B}	<0.001
Urine Toxicology cost, mean (SD)	0.89 (0.24)	22.15 (6.06)	1.01 (0.18) ^{C}	25.22 (4.49) ^{C}	0.76 (0.34) ^{B}	18.97 (8.52) ^{B}	0.012
Total Provider Cost, mean (SD)		**147.42 (43.06)** ^{B,C}		**220.01 (55.26)** ^{A,C}		**336.30 (61.20)** ^{A,B}	**<0.001**
Patient Costs							
Travel Time, mean (SD)	2.54 (1.11) ^{C}	18.84 (8.25) ^{C}	2.03 (1.42)	15.01 (10.56)	1.54 (1.19) ^{A}	11.40 (8.77) ^{A}	0.031
Visit Time, mean (SD)	1.12 (0.50) ^{B}	8.35 (3.66) ^{B}	1.67 (0.76) ^{A,C}	12.39 (5.60) ^{A,C}	0.79 (0.12) ^{B}	5.84 (0.90) ^{B}	<0.001
Subtotal: Patient Time, mean (SD)		27.19 (9.97) ^{C}		27.40 (12.56) ^{C}		17.25 (8.99) ^{A,B}	0.001
Child Care, mean (SD)		0		1.91 (7.00)		0	0.19
Transport Cost, mean (SD)		65.00 (134.95)		33.50 (22.08)		21.52 (30.31)	0.17
Total Patient Cost, mean (SD)		**92.14 (138.09)**		**63.14 (30.25)**		**38.78 (38.18)**	**0.102**
Total Cost, mean (SD)		**239.56 (145.97)** ^{C}		**274.83 (63.68)** ^{C}		**378.22 (72.01)** ^{A,B}	**<0.001**

^{A}Denotes a statistically significant difference from the MC group in post hoc testing

^{B}Denotes a statistically significant difference from the MO group in post hoc testing

^{C}Denotes a statistically significant difference from the BO group in post hoc testing

Table 5

Sensitivity analysis results for variation in unit cost estimates for the total cost of clinic-based methadone (MC) and office-based methadone (MO) and buprenorphine (BO)

		Unit Cost ($)		MC ($)		MO ($)		BO ($)	
	Unit	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Provider Cost									
Physician time[A]	hour	62.15	109.01	0	0	34.22	60.02	15.70	27.53
Nurse time[A]	hour	27.96	45.64	1.94	3.16	13.49	22.01	9.32	15.21
Counselor time[A]	hour	19.02	28.08	14.57	21.50	0.90	1.33	0	0
Subtotal: Clinician Costs				16.51	24.67	48.61	83.36	25.02	42.75
Overhead/Administrative [B]		18%	42%	2.97	10.36	8.75	35.01	4.50	17.95
Adjustment for missed visits[C]		5%	20%	0.97	7.00	2.87	23.67	1.47	12.14
Buprenorphine/naloxone [D]	mg.	0.53	0.79					257.32	383.55
Methadone [D]	mg.	0.05	0.05	92.87	92.87	86.14	86.14		
Urine toxicology screens [E]	test	4.47	54.67	3.96	48.43	4.51	55.15	3.39	41.47
Total Provider Cost				**117.29**	**183.35**	**149.10**	**278.73**	**292.24**	**499.29**
Patient Cost									
Patient Time Cost [F]	hour	5.15	18.62	18.92	68.41	19.07	68.94	12.00	43.39
Child Care	**$**			0	0	1.91	1.91	0	0
Transport Cost	**$**			64.95	64.95	33.50	33.50	21.52	21.52
Total Patient Costs				**83.87**	**133.36**	**54.74**	**105.02**	**33.55**	**64.92**
Total Cost									
TOTAL				**201.16**	**316.71**	**197.40**	**374.48**	**328.01**	**568.56**

[A] Low estimate is calculated from mean wage in a geographic area with a high concentration of professionals and includes 30% fringe rate. High estimate is based on the mean wage in an area with a low concentration of professions and includes 30% fringe rate

[B] Low and high estimate from previously published reports of methadone clinic expenses

[C] Range of estimates based upon attendance rates during the study periods

[D] Low estimate based on price paid at a local methadone clinic. High estimate based on price per mg of 8-mg tablet on an on-line national pharmacy available to the public.

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[E] Low estimate based on on-line price of 10- drug urine toxicology dip test. High estimate based on quantitative testing at a commercial laboratory

[F] Low estimate is the 2006 federal minimum wage. High estimate is 2006 national mean wage

Table 6

Treatment outcomes of patients receiving clinic-based methadone (MC), office-based methadone (MO) or buprenorphine (BO)

	Methadone		Buprenorphine	P-value
	MC	MO	BO	
Percent of patients retained in treatment for six months (n)	82.6 (19)	90.5 (19)	85.3 (29)	.75
Mean % of opioid-free urine samples (SD)	85.7 (30.3)	95.3 (7.7)	89.2 (20.8)	.34
Mean % of cocaine-free urine samples (SD)	95.9 (16.0)	95.9 (11.9)	95.0 (13.4)	.96
Mean % of benzodiazapine-free urine samples (SD)	85.6 (28.5)	86.4 (30.7)	96.6 (10.6)	.14
Mean % of urine samples free from opioids, cocaine, and benzodiazepines (SD)	75.2 (36.5)	79.2 (30.6)	86.0 (23.2)	.38