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Effect of incentives for medication adherence on health care use and costs in methadone patients with HIV

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Abstract

Background—The potential benefits of anti-retroviral therapy for HIV is not fully realized because of difficulties in adherence with demanding treatment regimens, especially among injection drug users.

Methods—HIV-positive methadone patients who were less than 80% adherent with their primary anti-retroviral therapy were randomized to a trial of incentives for on-time adherence. Adherence was rewarded with an escalating scale of vouchers redeemable for goods. Both intervention and control group visited a medication coach twice a month. The cost of the intervention was determined by micro-costing. Other costs were obtained from administrative data and patient report of out-of-system care.

Results—During the 12-week intervention period, the incremental direct cost of the intervention, including treatment vouchers, was $942. The voucher group incurred $2,572 in anti-retroviral drug cost, significantly more than the $1,973 incurred by the comparison group ($p<.01$). Adherence, as measured by on-time openings of an electronically monitored vial, was 78% in the intervention group and 56% in the control group.

Conclusions—The incremental direct cost of voucher incentives was $292 per month. If the observed increase in adherence from voucher incentives can be sustained in the long-term, the literature suggests that disease progression will be slowed. Further research is needed to evaluate if the improvement can be sustained or achieved at lower cost. Mitigation of treatment resistance and reduction in HIV transmission are additional benefits that favor adoption.

Key words (MeSh terms)

Anti-HIV Agents/therapeutic use; Health care costs; Methadone; Patient Compliance; Opioid-Related Disorders

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1. INTRODUCTION

The advent of Highly Active Anti-Retroviral Therapy (HAART) markedly reduced the morbidity and mortality from HIV/AIDS (Palella et al., 1998; Palella et al., 2003; Walensky et al., 2006). Although anti-retroviral treatment reduced HIV-related hospitalizations, it is expensive and has increased total health care cost (Keiser et al., 2001; Pinkerton and Holtgrave, 1999). Anti-retrovirals account for 73% of HIV health care costs (Schackman et al., 2006). Nevertheless, this treatment causes sufficient improvement in survival and quality of life to be cost-effective, with incremental cost-effectiveness ratios between $13,000 and $23,000 per Quality-Adjusted Life Year (QALY) (Freedberg et al., 2001).

The potential benefit of anti-retroviral therapy is not being fully realized. An important limitation is the relatively poor adherence to the demanding treatment regimen. Adherence rates are 60% to 90%, depending on the adherence measure and the population studied (Bangsberg et al., 2000; Bangsberg et al., 2001; Gifford et al., 2000). Poor adherence with anti-retroviral treatment has been associated with higher HIV viral loads (Gifford et al., 2000; Paterson et al., 2000), progression to AIDS (Bangsberg et al., 2001), and death (Hogg et al., 2002). Among patients with low CD4 counts, failure to fill enough HAART prescriptions to cover at least 75% of the first year of follow-up resulted in 5 times the relative risk of death (Wood et al., 2003b).

A number of different strategies have been developed to improve treatment adherence. Short-term trials have shown that a variety of methods can be used to improve medication adherence, but longer-term studies have been less successful in showing sustained improvements or actual improvements in health (Haynes et al., 2005). Interventions have included information, counseling, reminders, reinforcement, and direct supervision (Lucas et al., 2007; Tuldra and Wu, 2002; Uldall et al., 2004). Directly observed therapy programs are effective (Kagay et al., 2004; Lanzafame et al., 2000; Mitty and Flanigan, 2004) but they are probably too expensive to be cost-effective (Bozzette and Gifford, 2003).

HIV-positive injection drug users have realized smaller benefits from HAART than other individuals with the disease. A study at one site found that the advent of HAART was associated with a 34% increase in the disease free survival of injection drug users, compared to a 135% increase in non-injection drug users (Poundstone et al., 2001). Although treatment rates have been increasing, injection drug users are less likely to obtain any anti-retroviral therapy or HAART (Celentano et al., 2001).

Once HAART has been prescribed, injection drug users are also more likely to have difficulty with adherence (Lucas et al., 2001). Reduction in substance abuse and enrollment in methadone maintenance are associated with improved adherence (Lucas et al., 2002).

Contingency management has been successfully employed in methadone treatment (Calsyn et al., 1994; Hall et al., 1977; Sindelar et al., 2007). Voucher incentives have helped methadone patients reduce their use of opiates (Silverman et al., 1996b) and cocaine (Silverman et al., 1996a). Contingency management has improved methadone patients' adherence with medications, including treatment for tuberculosis (Elk et al., 1993). A pilot study showed that behavioral training and cash reinforcements can improve short-term adherence among HIV-positive patients with substance use disorders (Rigsby et al., 2000).

We conducted a clinical trial to test a contingency management program to improve the HAART adherence of HIV-positive clients of a methadone maintenance program. In a previous paper, we reported effectiveness findings (Sorensen et al., 2007). We now describe the cost of the intervention, its effect on health care utilization and cost, and its potential cost-effectiveness.

2. METHODS

This randomized controlled trial evaluated incentives for medication compliance among HIV-positive patients enrolled in two methadone maintenance clinics in San Francisco, California. Incentives were provided in the form of vouchers redeemable for goods. It was considered unethical to randomize individuals with documented adherence problems to standard care, so the control group was provided with medication coaching. The trial evaluated the incremental effect of voucher incentives in patients who received medication coaching.

2.1 Inclusion and exclusion criteria

Methadone maintenance patients who were HIV-positive were eligible for enrollment if they had been taking an anti-retroviral medication for at least one month. Participants in other adherence research and those living in facilities that dispense medications to residents were excluded. Informed consent was provided in a protocol approved by the committee on human subjects' protection of UC San Francisco. Randomization began in May 2001 and follow-up was completed in January 2004.

The study began with a 4-week long baseline evaluation of adherence. A medication coach identified the anti-retroviral medication that presented the greatest adherence problem. A medication vial capped with an electronic monitoring device was used to determine the number of openings that were on-time. Cap openings were considered on-time if they were within 2 hours before or after the scheduled dosage for the key medication. Participants with less than 80% adherence were randomized to voucher intervention or a comparison group. The intervention was provided for 12 weeks. This was followed by a 4-week follow-up period. The medication coach met with participants in both groups every two weeks during the intervention and follow-up period. Sessions were designed to improve participants' adherence skills.

2.2 Treatment groups

2.2.1 Voucher Incentive Intervention—Vouchers were dispensed contingent on adherence to anti-retroviral medication, as measured by the electronic monitoring vial. Adherence was monitored twice weekly and incentive earnings reported to the participant. An escalating schedule rewarded sustained adherence. The participant could accumulate earnings before choosing a voucher redeemable for groceries, meals, and other goods. Perfect adherence would result in the participant receiving a maximum of $1,172 in vouchers over the 12-week intervention period.

2.2.2 Comparison group—A weekly lottery was used to maintain morale and reduce attrition among comparison group participants (Sorensen et al., 2007). There was one chance in three of winning a small prize (such as a snack, soap, lotion, or nutritional drink, worth one to two dollars) and a one chance in 350 of a larger prize (television, microwave oven, video cassette recorder, or stereo valued at approximately $80).

2.3 Assessments

Adherence of all patients was assessed twice a week using three methods: self-report, count of pills, and download of the electronic medication cap. Patients were asked monthly to report health care obtained outside of the county system and to describe their current health status using the Medical Outcomes Trust Short Form health survey (SF-36). Monthly blood draws were tested for plasma HIV RNA, CD4 count, and drug toxicology. We defined virus as controlled if the participant had no detectable virus at follow-up, or if the virus level had decreased from the baseline value by 1.0 on the log scale. Participants received modest monetary compensation for completed assessments.

2.4 Cost

2.4.1 Cost of screening, medication coaching, and vouchers—We estimated the cost of replicating the intervention in clinical practice. We adopted the perspective of the health care payer. We excluded the cost of research assessments. Since replication of the intervention in clinical practice would require the expense of identifying patients with adherence problems, we included the cost of screening.

We estimated the time each staff member spent in visits for medication coaching, adherence assessment, and voucher distribution. We used activity reports to assess time spent reminding participants of these visits. Labor costs included the hourly wage and an additional 22% for employer taxes and contributions for health insurance, workers' compensation, and retirement. Activity reports from randomly sampled days revealed that project staff spent 20% of their time on activities that could not be assigned to any project, such as attending meetings, responding to phone calls, training, vacation, holidays, and sick-leave. This person-level overhead was added to cost estimates. Finally, we added a facility overhead rate of 25% for space, utilities, and administrative support. This is an estimate of the indirect costs of operations at research hospitals (Barnett and Garber, 1996). All costs were expressed in 2003 dollars.

2.4.2 Cost of within-system health services—We gathered data on all health care and substance abuse treatment costs. The possibility of earning a voucher reward may have increased adherence to methadone treatment among those randomized to the voucher incentive group. To consider this possibility, we included the cost of substance abuse treatment. Guidelines for cost-effectinvess research recommend that cost data be comprehensive (Luce et al., 1996).

We obtained administrative data from the medical services, mental health, and substance abuse treatment data systems of the San Francisco Department of Public Health. Hospital charges were adjusted by the hospital-wide cost-to-charge ratio for the year in which the service was provided. We used the contract cost for mental health and substance abuse treatment.

2.4.3 Cost of out-of-system health services—When a hospital stay outside of the county system was reported, the participant was asked to sign a release and the hospital bill was obtained. Charges were adjusted by the ratio of cost to charges. We used the mean cost of participants' county system visits to estimate the cost of out-of-system emergency room visits ($461), medical visits ($167), outpatient mental health visits ($141), methadone treatment ($12), residential stays ($99 per day), and outpatient drug treatments visit other than methadone ($52).

2.4.4 Medication cost—All anti-retroviral medication use was recorded. Cost was estimated using the recommended daily dosage with quantity adjusted by adherence rates as measured by pill counts. We estimated cost using the average wholesale price (Cohen, 2003) adjusted for our estimate of the average discount paid by the AIDS Drug Assistance Program (ADAP) in 2003. We compared wholesale prices to the mean cost to ADAP in each drug class category (Leibowitz and Sood, 2007). We applied the result, estimating anti-retroviral drugs cost 70.4% of the wholesale price. We used costs to the ADAP program as it is the dominant payer of anti-retroviral medication costs in the U.S.

2.5 Statistical methods

We used all available data in an "intent-to-treat" analysis, including all randomized participants regardless of whether all assessments were completed. Many utilization observations had zero values (e.g., number of hospital stays). Costs were skewed by exceptional events. Since

utilization and costs are not normally distributed, treatment group were compared by a non-parametric method, the Mann-Whitney Wilcoxon rank-sum test.

We had complete administrative data for all participants. We relied on self-reported health care utilization to estimate out-of-system cost. There were 7 participants who missed the final assessment. We assumed that these participants incurred no out-of-system costs after their last completed assessment. This assumption was likely benign, as out-of-system costs accounted for a fraction of the total.

Since out-of-system health care utilization was reported for time periods defined by assessments, we used the date of the assessment to define the follow-up period, and controlled for differences in the length of the follow-up by determining the cost per unit of time, where the unit of time was the 12 weeks of intervention or the 4 weeks of follow-up.

3. RESULTS

A total of 86 individuals were eligible and agreed to participate in the study. Of these, 66 completed the 4-week baseline assessment with less than 80% adherence to their key anti-retroviral medication. Randomization assigned 34 participants to voucher incentives and 32 to the comparison group. At intake, participants had a mean CD4 count of 300 and a median viral load of less than 75 copies/mL. Half had viral levels below the limit of quantifiable detection. Two participants died during the intervention period; their data are included in the analysis. Characteristics of study participants are given in Table 1.

3.1 Unit costs

Screening during the 4-week baseline observation period cost $42.53 per patient, including the evaluation of participant eligibility, identification of the medication to monitor, and monitoring. Of 103 individuals screened, 86 underwent baseline evaluation and 66 were randomized. Thus for each patient randomized, another 0.56 patients were screened who were too adherent to justify intervention or dropped out before randomization. We assigned a screening cost of $66.37 ($66.37=1.56 × $42.53) to those randomized to the voucher group.

We estimated that medication management visits cost $44.71. This included the time of the medication coach counseling the patient and documenting care. Also included was the cost of time that research assistants spent on visit reminders, maintaining the medication log, downloading the monitoring cap, and preparing an adherence report for the medication coach. The electronic monitoring cap and medication reminder timer cost $95 per patient.

Participants were scheduled for voucher visits twice each week. These visits cost $8.50 each. This represents the cost of visit reminders, downloading data from the electronic cap on the medication vial, calculating voucher incentive earnings, and dispensing vouchers.

We estimated the cost of administering the voucher program by the study manager. The average administrative cost was $135 per week. We estimated that $123 of vouchers were issued each week during the peak of study activity. For every dollar cost of the voucher, there was an additional $1.10 in administrative cost ($1.10=135/123).

3.2 Cost and utilization

Health care utilization is presented in Table 2. During the 12-week intervention period, the voucher group obtained an average 5.5 coaching visits and the comparison group 5.0 visits, a difference that was not statistically significant.

Mean health care cost per participant are presented in Table 3. The voucher intervention cost an average of $942. This cost included the $66 for initial screening, the $378 face value of the vouchers, $416 for vouchers' administrative cost, and $81 for adherence assessments and follow-up reminders. After screening, the intervention cost an average of $292/month.

Anti-retroviral drugs prescribed to the voucher group cost $2,572 during the 12-week intervention period. This was significantly greater than the $1,973 in anti-retroviral costs incurred by the comparison group ($p<.01$).

The voucher group incurred a mean of $1,871 in medical care costs, compared to a mean of $3,099 incurred during the intervention period by the comparison group. This difference was not statistically significant. One member of the comparison group was hospitalized for 16 days, at a cost of $48,595. With this outlier excluded, the comparison group incurred a mean of $2,688 in medical care costs.

During the intervention period, the voucher group incurred significantly more total cost, including the cost of intervention, coaching, medical care, and HAART pharmacy ($p<.01$).

During the 4 week follow-up period, the groups had no significant differences in health care utilization. The voucher group had higher substance abuse treatment costs ($p<.05$) and higher total costs during the follow-up period ($p<.05$).

During the entire 16 weeks after randomization, the voucher group incurred a significantly higher cost for anti-retroviral therapy ($p<.05$) and a significantly higher total health care cost ($p<.05$).

3.3 Adherence and Outcomes

Outcomes are reported in Table 4. Participants randomized to incentive vouchers were significantly more adherent during the 12-week intervention period, as determined by self-report, pill count, and on-time opening of the medication monitoring bottle. On-time openings were 78% in the voucher group, and 56% in the comparison group ($p<.001$). The voucher group had increased its on-time openings from 50% at baseline. The comparison group had 52% on-time openings at baseline.

During the 4 week post-intervention monitoring period, adherence by electronic monitoring fell to 66% in the voucher group, which was not significantly greater than the 53% adherence rate in the comparison group ($p=.07$). There were no significant differences between treatment groups in HIV-1 RNA levels, CD4 counts, or health status as measured by SF-36 at any point in time.

4. DISCUSSION

This study showed that voucher incentives can improve the adherence to anti-retroviral therapy of HIV-positive patients enrolled in methadone maintenance.

4.1 Cost of the intervention

Over the course of the study, participants assigned to the voucher intervention received $942 related to vouchers and $417 in medication coaching services. The cost of this effort to improve adherence, ($1,359) accounted for 14.4% of the total health care cost of the voucher group and was equivalent to 39.6% of the cost of their anti-retroviral drugs.

The voucher intervention had an initial cost of $66 and an ongoing cost of $292 per month. This was much more than the median cost of $35/month for other anti-retroviral adherence

interventions described in a recent review (Schackman et al., 2005). The voucher intervention involved 8 visits a month, compared to an average of 2 visits a month for other interventions. Our medication coaching intervention was also more expensive, with an initial cost of $95 and an ongoing cost of $82 per month. Our cost estimates were not strictly comparable, as we included the cost of clinic space, time of staff when not directly involved in providing the intervention, and other indirect costs not in the estimates prepared by Schackman.

The voucher intervention cost less than directly observed therapy. Programs that directly administer of tuberculosis drugs are estimated to cost about $20 per treatment visit (Snyder and Chin, 1999); daily visits would result in a cost of $600/month. While the costs of programs that directly administer HIV drugs have not been reported, they are estimated to cost between $473 (for observation of one dose each weekday) and $1,559 per month (for direct observation of two doses every day) (Goldie et al., 2003).

4.2 Outcomes

In the short-run, randomization to voucher incentives resulted in statistically significant higher adherence, whether measured by self-report, pill count, or electronic monitoring. The lack of any statistically significant difference in viral load, CD4, or SF-36 undoubtedly reflects the limitations of the study: its small sample size, short follow-up time, and the fact that virus was already controlled in half of the study participants at baseline. All three of these measures showed a trend towards improved health, however. In each case, the voucher group had a better value, but the difference was not statistically significant.

We reviewed the literature on anti-retroviral adherence to consider if the improved adherence caused by this intervention is likely to slow disease progression and reduce mortality. Patients who are 70% and 80% adherent have less risk of failure than those who are less than 70% adherent (Gross et al., 2001; Maggiolo et al., 2005; Paterson et al., 2000). Patients who are taking the more recently developed non-nucleoside reverse transcriptase inhibitor (NNRTI) based therapy do better at lower levels of adherence than those on protease inhibitor combination therapy (Nachega et al., 2007; Tuboi et al., 2005). A recent study found NNRTI therapy beneficial as long as adherence was above 50% (Nachega et al., 2007). Each 10% increase in adherence above this level was associated with a .10 increase in the absolute proportion of patients who sustained viral suppression.

It has been reported that successful long-term treatment of HIV/AIDS requires adherence levels of at least 95% (Chesney, 2003) The intervention did not achieve this threshold. The 95% adherence threshold may reflect the limitations of some earlier adherence studies. Some studies have found better outcomes from 95% adherence without considering lower thresholds (Collier et al., 2005). Two studies that found better outcomes when adherence exceeded 95% reported that their findings were not sensitive to use of a 75% threshold to define adherence (Raboud et al., 2002; Wood et al., 2003a).

These cross-sectional studies suggest that there will be long-term benefit if the increased adherence obtained by voucher incentives can be sustained over the long-run. The effect of the incentives on adherence depended on the measurement method, adding to the uncertainty about the exact magnitude of this benefit.

The improvement in adherence was sustained as long as the voucher incentives were offered; when these incentives were withdrawn, adherence rates declined. It thus appears that voucher incentives must be ongoing to have a long-term impact.

4.3 Cost-effectiveness

Even if improved adherence from this intervention causes long-run improvements in health, it does not follow that these benefits are sufficient to justify its cost.

A model developed to evaluate the cost-effectiveness of adherence interventions found that interventions for early stage HIV patients that cost $250 per month must reduce the rate at which viral control fails by at least 20% for the incremental cost-effectiveness ratio to be less than $50,000/QALY (a threshold commonly used in the U.S.) (Goldie et al., 2003). Interventions that cost $500 per month must reduce failure rates by more than 50%.

We tested a voucher incentive program that cost $292/month. According to this model, it will need to reduce treatment failure by more than 20% to be considered cost-effective.

4.4 Limitations

The findings from this study are limited by the small sample size and short-time frame. Administrative costs were high, and might be reduced by economies of scale if the intervention were provided to a larger number of patients.

The ideal design would have compared the intervention to standard care. Had the control group been provided standard care, the incremental cost of the intervention would have been greater, but the study might also have found greater incremental effectiveness.

The intervention period was 12 weeks. The improvement in adherence eroded when voucher incentives were withdrawn. A longer trial may show whether incentives would lose their effect over time, or whether the effect can be sustained without further incentives, lowering cost. For a given cost and effectiveness, adherence interventions are more cost-effective when provided to sicker patients (Goldie et al., 2003). If voucher incentives result in the same adherence improvement in more seriously ill patients, this intervention will be more cost-effective if this group is targeted.

We adopted the perspective of a single adopted by this paper may be artificial, as substance abuse treatment, medical care, and AIDS medications may be sponsored by different payers. Some patients have a single sponsor, including those covered by some states' Medicaid program, some county indigent care systems, or the Department of Veterans Affairs.

4.5 Implications

HIV-positive patients in methadone maintenance responded to voucher incentives by improving their adherence with anti-retroviral medication. Health care sponsors are willing to pay for anti-retroviral medications. They may find it cost-effective to augment this expenditure by 40% to promote the timely and effective use of these drugs.

A key question is whether policy makers will approve payments to patients to achieve a desired behavior, as this program falls outside the definition of traditional health services. They may be more willing to adopt less effective interventions simply because they fit the traditional definition of health care.

Poor adherence leads to the development of strains of HIV that are resistant to some classes of anti-retrovirals (Bangsberg et al., 2004). By slowing drug resistance, programs that improve adherence confer an important public health benefit. Poor adherence also leads to high viral loads. Since some methadone maintained individuals remain occasional injection drug users, improved adherence reduces HIV transmission, another benefit to public health. These outcomes represent additional considerations that favor the implementation of adherence programs.

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Table 1

Means (and standard deviation) of baseline characteristics of study participants by treatment group

	Incentive Voucher with Coaching		Medication Coaching Alone	
Number of participants	34		32	
Gender (% female)	35		47	
Age (years)	44.0	(7.8)	42.6	(7.8)
Ethnicity				
Caucasian (%)	44		28	
African-American (%)	26		37	
Latino (%)	15		9	
Other (%)	17		26	
Married (%)	24		3	
Employed (full or part-time, %)	9		0	
Yearly income < $10,000 (%)	85		81	
Opiates (% positive urine screen)	35		41	
Cocaine (% positive urine screen)	53		50	
Addiction Severity Index drug composite	0.21	(0.1)	0.21	(0.1)
Addiction Severity index alcohol use composite	0.09	(0.2)	0.04	(0.1)
SF-36 physical health summary	24.6	(1.2)	24.3	(1.5)
Plasma HIV-1 RNA (copies) [median]	8,885	[57]	21,063	[0]
Plasma HIV-1 RNA < 75 copies/ml detection limit (%)	50.0		50.0	
CD4+ (Cells/UL)	302	(198)	299	(330)
Adherence by electronic monitor during baseline period (%)	50.1	(17.2)	51.9	(20.0)
Adherence by pill count during baseline period (%)	70.5	(20.9)	79.1	(18.8)
Adherence by self-report during baseline period (%)	75.0	(22.4)	75.9	(25.0)

Table 2

Mean (standard deviation) of health care utilization by treatment group and study phase

	Intervention period				Follow-up period			
	Incentive Voucher with Coaching		Medication Coaching Alone		Incentive Voucher with Coaching		Medication Coaching Alone	
Medication coach visits	5.50	(301.24)	5.00	(1.68)	1.71	(0.58)	1.56	(0.80)
Voucher dispensing visits	9.50	(3.47)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Long-term methadone (days)	75.03	(14.52)	75.08	(15.57)	28.97	(6.74)	27.96	(8.27)
Detoxification methadone (days)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Residential substance abuse treatment (days)	2.81	(11.54)	0.00	(0.00)	1.61	(5.85)	1.25	(5.86)
Residential substance abuse treatment (stays)	0.14	(0.54)	0.00	(0.00)	0.08	(0.27)	0.04	(0.18)
Outpatient substance abuse treatment (days)	1.71	(6.56)	2.24	(8.86)	1.45	(4.65)	0.47	(2.67)
Outpatient mental health care (days)	0.30	(1.25)	1.76	(4.43)	0.18	(0.80)	0.66	(2.15)
Inpatient mental health (days)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Inpatient medical care (days)	0.22	(0.82)	0.98	(3.30)	0.08	(0.48)	0.00	(0.00)
Inpatient medical care (stays)	0.12	(0.43)	0.19	(0.49)	0.03	(0.16)	0.00	(0.00)
Emergency room visits	0.31	(0.71)	0.13	(0.34)	0.04	(0.18)	0.03	(0.17)
Outpatient medical care (days)	6.19	(3.74)	5.61	(6.56)	2.20	(1.79)	1.77	(1.89)

Table 3

Mean (and standard deviation) of health care cost in U.S. dollars by treatment group and study phase

	Intervention period					Follow-up period				
	Incentive Voucher with Coaching		Medication Coaching Alone			Incentive Voucher with Coaching		Medication Coaching Alone		
Medication coaching	341	(55)	319	(75)		76	(26)	70	(36)	
Voucher administration	942	(566)	0	(0)		0	(0)	0	(0)	
Long-term methadone	1,212	(354)	1,148	(330)		477	(168)	412	(144)	
Detoxification methadone	0	(0)	0	(0)		0	(0)	0	(0)	
Residential substance abuse treatment	237	(1,124)	0	(0)		160	(582)	124	(583)	
Outpatient substance abuse treatment	100	(352)	82	(323)		66	(212)	15	(84)	
Subtotal, substance abuse treatment	1,549	(1,220)	1,230	(454)		703	(664)	551	(614)	$p < 0.05$
Outpatient mental health care	26	(115)	278	(728)		25	(113)	91	(290)	
Inpatient mental health care	0	(0)	0	(0)		0	(0)	0	(0)	
Inpatient acute medical care	763	(3,190)	2,356	(7,383)		156	(908)	0	(0)	
Emergency room	115	(342)	43	(135)		20	(84)	11	(65)	
Outpatient medical care	993	(971)	701	(810)		303	(302)	268	(299)	
Subtotal, medical care	1,871	(3,530)	3,099	(7,607)		479	(1,002)	279	(319)	
Anti-retroviral pharmacy cost	2,572	(842)	1,973	(972)	$p < 0.01$	864	(428)	755	(373)	
Total cost	7,301	(3,886)	6,899	(7,477)	$p < 0.01$	2,146	(1,206)	1,739	(910)	$p < 0.05$

Table 4

Mean (standard deviation) of outcomes by treatment group and study phase

	Intervention period					Follow-up period			
	Incentive Voucher with Coaching		Medication Coaching Alone			Incentive Voucher with Coaching		Medication Coaching Alone	
Adherence by MEMS on time openings (%)	77.6	(17.5)	55.5	(23.1)	p<.001	66.0	(23.9)	53.1	(29.2)
Adherence by pill count (%)	85.9	(11.4)	75.4	(21.3)	p<.05	80.9	(18.3)	78.4	(28.4)
Adherence by self-report (%)	87.3	(14.0)	68.7	(17.7)	p<.001	80.6	(21.2)	71.6	(25.5)
Plasma HIV-1 RNA (copies) [median]	6,880	[0]	5,550	[0]		15,933	[0]	2,908	[0]
Viral load controlled (% at last visit)	61.8		68.8			67.7		60.0	
CD4+ (Cells/UL)	302	(194)	314	(165)		324	(216)	360	(195)
SF-36 physical health summary score	39.7	(8.7)	35.2	(8.1)		37.2	(10.0)	35.3	(9.5)