



## Impact of Monetary Incentives on Adherence to Referral for Screening Chest X-rays After Syringe Exchange–Based Tuberculin Skin Testing

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**ABSTRACT** Introduction. *Syringe-exchange programs (SEPs) have proven to be valuable sites to conduct tuberculin skin testing among active injection drug users. Chest x-rays (CXR) are needed to exclude active tuberculosis prior to initiating treatment for latent tuberculosis infection. Adherence of drug users to referral for off-site chest x-rays has been incomplete. Previous cost modeling demonstrated that a monetary incentive to promote adherence could be justified on the cost basis if it had even a modest effect on adherence.*

Methods. *We compared adherence to referral for chest x-rays among injection drug users undergoing syringe exchange–based tuberculosis screening in New York City before and after the implementation of monetary incentives.*

Results. *From 1995 to 1998, there were 119 IDUs referred for CXRs based on tuberculin skin testing at the SEP. From 1999 to 2001, there were 58 IDUs referred for CXRs with a \$25 incentive based on adherence. Adherence to CXR referral within 7 days was 46/58 (79%) among individuals who received the monetary incentive versus 17/119 (14%) prior to the implementation of the monetary incentive ( $P < .0001$ ; odds ratio [OR] = 23; 95% confidence interval [CI] = 9.5–57). The median time to obtaining a CXR was significantly shorter among those given the incentive than among those referred without the incentive (2 vs. 11 days,  $P < .0001$ ). In multivariate logistic regression analysis, use of the incentive was highly independently associated with increased adherence (OR = 22.9; 95% CI = 10–52).*

Conclusions. *Monetary incentives are highly effective in increasing adherence to referral for screening CXRs to exclude active tuberculosis after syringe exchange–based tuberculin skin testing. Prior cost modeling demonstrated that monetary incentives could be justified on the cost basis if they had even a modest effect on adherence. The current data demonstrated that monetary incentives are highly effective at increasing adherence in this setting and therefore are justifiable on a cost basis. When health*

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This work was supported by the National Institute of Drug Abuse (RO1-DA9005). None of the authors has any financial or other conflict with the contents of the manuscript.

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*care interventions for drug users require referral off site, monetary incentives may be particularly valuable in promoting adherence.*

**KEYWORDS** *Adherence, Drug users, Incentives, Tuberculosis.*

## INTRODUCTION

Drug users are at high risk of tuberculosis (TB) infection and disease.<sup>1-3</sup> Drug treatment programs are valuable settings in which to screen drug users for tuberculosis infection and to deliver observed tuberculosis preventive therapy.<sup>3</sup> However, at any given time the great majority of drug users are not in drug treatment; hence, alternative strategies to deliver tuberculosis services to out-of-treatment drug users are needed.<sup>4</sup> Syringe-exchange programs (SEPs) have proven to be valuable sites to conduct tuberculosis skin testing.<sup>5-7</sup> Acceptance of tuberculosis services at SEPs has been high, and many syringe exchanges offer tuberculosis skin testing.<sup>5-8</sup> Return rates to have tuberculin skin tests read at SEPs in various settings have been good, ranging from 78% to 91% with various modest incentives.<sup>5-7</sup>

Tuberculosis screening is a multistep endeavor.<sup>9</sup> The goal of tuberculin skin testing is to identify persons latently infected with *Mycobacterium tuberculosis* who would be candidates for treatment of latent tuberculosis infection (LTBI) to reduce their risk of progression to active tuberculosis. A central component of this evaluation is excluding active tuberculosis in those found by tuberculin skin testing to be latently infected. This is critical both so that those with active disease can be appropriately treated with multidrug regimens and so that monotherapy is not inadvertently given to those with unsuspected active disease as this may promote the development of acquired drug resistance.

Active disease is excluded based on a clinical evaluation of the patient and on the findings of a chest x-ray (CXR). Therefore, the ultimate utility of any tuberculin skin testing initiative rests on the ability to have screened persons complete all of the steps of tuberculosis screening and be engaged in and complete appropriate treatment of LTBI.<sup>9,10</sup>

While tuberculosis skin testing is a reasonably simple intervention that can be performed in field and community-based settings, the CXR screening required for those latently infected requires a more substantial health care infrastructure than is found in syringe-exchange or field settings. In conducting tuberculosis screening at a storefront SEP in New York City, we initially referred those latently infected for free screening chest radiographs at a nearby health facility.<sup>5</sup> Only 34% of injection drug users (IDUs) adhered to referral for screening CXRs.<sup>5,11</sup> Incomplete adherence to this step of TB screening limits the ability to identify appropriate candidates for preventive therapy. Nonetheless, even with the observed limited adherence to this step of TB screening, we found that overall TB screening and observed treatment of LTBI performed at an SEP remained both a cost-effective and a potentially cost-saving intervention.<sup>11</sup>

To explore the potential cost impact of interventions to improve adherence to this step of TB screening, we examined the effect of a monetary incentive on adherence with respect to cost-effectiveness and found that a monetary incentive could be justified on a cost basis if it had even a modest effect on adherence.<sup>11</sup> If an incentive of \$25 were able to increase the observed rate of CXR referral adherence from the observed 34% to even 50%, significant additional cost savings would be realized.<sup>11</sup>

We therefore initiated a system in which an incentive of \$25 was given to IDUs screened at the SEP; the incentive was contingent on adhering to referral for the screening chest x-ray within 7 days of referral. We now report on the impact of a monetary incentive on adherence to referral for CXRs to exclude active tuberculosis after SEP-based tuberculin skin testing.

## **METHODS**

### **Setting**

The Lower East Side Needle Exchange Program is one of several legally sanctioned SEPs in New York City. It is a storefront facility located in the Lower East Side of Manhattan, an ethnically diverse inner-city area with a high prevalence of TB. The exchange has over 8,000 registered participants and is open 6 days each week. There are no chest radiograph or other medical facilities located on site.

### **Screening**

Tuberculosis screening was offered to all exchange participants during syringe-exchange sessions as previously described.<sup>5,11,12</sup> Institutional review board approved consent was obtained from all study participants. At first contact, participants were offered tuberculin skin testing, underwent a staff-administered interview, and were offered human immunodeficiency virus (HIV) counseling and testing. Accepting participants were asked to return 48–72 hours later, at which time they would receive \$15.00 (\$10.00 cash and \$5.00 transportation tokens).

### **Skin Testing**

Study participants were tested with 0.1 mL (5 TU) of tuberculin purified protein derivative (PPD) (Connaught Laboratories, Swiftwater, PA) placed intradermally on the volar aspect of the left forearm. The transverse diameter of induration was measured with a millimeter ruler at 48–72 hours. Interpretation was done by specifically trained health educators according to standard guidelines.<sup>9,12</sup> A positive PPD tuberculin test was defined as an induration of 10 mm or larger in known HIV-negative persons and 5 mm or larger induration in all others.

### **Assessment of Patients for Eligibility for Treatment**

Patients with a positive PPD (overall TB infection prevalence 19%) were evaluated for clinical TB. Patients underwent a focused clinical examination by a physician's assistant. Consecutive patients who had latent TB by skin testing, had not previously completed a course of TB preventive therapy, and who did not have medical contraindications to isoniazid treatment of latent TB (assuming their CXR would exclude active TB) were referred off site for free screening CXRs.

From 1995 to 1998, subjects referred for screening CXRs were provided with a referral slip for the CXR and transportation tokens (\$5.00 cash equivalent) to facilitate access to the nearby radiology facility (a hospital-based outpatient office 15 blocks from the syringe exchange), but not with any additional incentive. The radiology facility performed the CXRs on a same-day basis for those who showed up. From 1999, subjects were offered an additional \$25 cash incentive contingent on adherence to CXR referral within 7 days of referral.

For both time periods, whether and when CXRs had been performed (and CXR results) were assessed by accessing a computer information system maintained at

the radiology facility. During the incentive study period, study personnel accessed the radiology information system in real time from the SEP site and provided individuals with the \$25 incentive after verifying that the CXR had been performed.

On-site directly observed treatment of LTBI with twice-weekly isoniazid was offered when active TB was excluded. When suspicious radiographic findings resulted in a confirmed or presumptive TB diagnosis, TB directly observed therapy was arranged in appropriate settings.

### Data Analysis

Data were collected through staff-administered questionnaires, entered into a database (Paradox 4.0, Borland, Scotts Valley, CA), and analyzed using SAS software (version 8, SAS Institute, Cary, NC). Univariate analyses were made using the chi-square test for categorical data and the *t* test for continuous data. Stepwise logistic regression analyses were used to assess the independence of potential predictors of adherence to referral for screening CXRs. Adherence was defined as having had the CXR performed within a specific time frame (7 days, 30 days, or ever) as documented in the radiology information system. All baseline characteristics that showed a univariate *P* value less than .1 were selected for inclusion in the model. Pearson correlation coefficients were used to assess interactions among the variables. Odds ratios (ORs) and 95% confidence intervals (CIs) are reported for all variables remaining in the models with a *P* value of less than .05.

### RESULTS

From 1995 to 1998, there were 119 IDUs referred for CXRs based on tuberculin skin testing at the SEP. From 1999 to 2001, there were 58 IDUs referred for CXRs with a \$25 incentive based on adherence. The demographic characteristics of those referred are depicted in Table 1. The cohorts referred were comparable with respect to most demographic and clinical characteristics. However, the earlier cohort was slightly younger (mean age 37.8 versus 42.3 years,  $P < .002$ ).

Adherence to CXR referral was 48/58 (83%) among individuals who received the monetary incentive versus 41/119 (34%) prior to the implementation of the monetary incentive ( $P < .0001$ ; OR = 9.1; 95% CI = 3.9–22). Adherence to CXR referral within 7 days was 46/58 (79%) among individuals who received the monetary incentive versus 17/119 (14%) prior to the implementation of the monetary incentive ( $P < .0001$ ; OR = 23; 95% CI = 9.5–57).

The time from the initial referral for the screening CXR to its performance is depicted in Table 2. The median time to obtaining a CXR was significantly shorter among those given the incentive than among those referred without the incentive (2 vs. 11 days,  $P < .0001$ ).

We examined factors associated with CXR adherence within 7 days of referral (dependent variable) among the referred IDU population as a whole, considering the offer of the incentive as a potential independent predictor, to examine whether use of the monetary incentive was independently associated with adherence to CXR referral. Factors associated with adherence in univariate analysis are depicted in Table 3. In multivariate logistic regression analysis, use of the incentive was strongly and independently associated with an increased likelihood of adherence (OR = 22.9; 95% CI = 10.1–52) (Table 4).

We also examined factors associated with getting the CXR within 30 days or ever (univariate data not shown); in each case, we found that receipt of the incentive

**TABLE 1. Cohorts of injecting drug users (IDUs) requiring chest x-ray to exclude active tuberculosis after syringe exchange–based tuberculin skin testing: prior to and after initiation of monetary incentive for adherence**

Factor	No incentive (N = 119),*		Incentive (N = 58),		Univariate P value
	n	(%)	n	(%)	
Mean age, years	38		43		.002
Gender					
Male	83	(70)	34	(59)	.14
Female	36	(30)	24	(41)	
Race/ethnicity					
Non-Hispanic black	28	(24)	23	(40)	.12†
Non-Hispanic white	41	(34)	21	(36)	
Hispanic	35	(29)	12	(21)	
Other	15	(13)	2	(3)	
Adherence to chest x-ray within 7 days					
Yes	17	(14)	46	(79)	<.0001
No	102	(86)	12	(21)	
Unstably housed	66	(55)	39	(67)	.13
Stable housing	53	(45)	19	(33)	
Employed	20	(17)	4	(7)	.07
Unemployed	99	(83)	54	(93)	
Health insurance	80	(67)	37	(64)	.65
No health insurance	39	(33)	21	(36)	
Education 12th grade or higher	73	(61)	36	(62)	.97
Education less than 12th grade	44	(37)	22	(38)	
Known HIV infected	21	(18)	8	(14)	.51
Not known HIV infected	98	(82)	50	(86)	
Alcohol to intoxication (past 6 months)					
Yes	51	(43)	26	(45)	.80
No	68	(57)	32	(55)	
Daily injection (past 6 months)					
Yes	54	(45)	21	(36)	.25
No	65	(55)	37	(64)	
Heroin use (past 6 months)					
Yes	76	(64)	38	(66)	.83
No	43	(36)	20	(34)	
Cocaine use (including crack) (past 6 months)					
Yes	77	(65)	35	(60)	.57
No	42	(35)	23	(40)	
Speedball use (past 6 months)					
Yes	50	(42)	16	(28)	.06
No	69	(58)	42	(72)	
Currently in drug treatment	51	(43)	24	(41)	.85
Not in drug treatment	68	(57)	34	(59)	

\*N's may vary slightly due to missing data.

†For the comparison of black, white, and hispanic.

**TABLE 2. Time to obtaining tuberculosis screening chest x-ray after referral from syringe exchange**

Time, days	No incentive (N = 119),		Incentive (N = 58),	
	n	(%)*	n	(%)
≤7	17	(14)	46	(79)
8–30	9	(8)	1	(2)
31–60	8	(7)	1	(2)
61–90	2	(2)	0	(0)
≥91	5	(4)	0	(0)
Never	78	(66)	10	(17)

\*Percentages may not total 100% due to rounding.

was independently associated with adherence (ORs = 15.3 and 9.7, respectively) (Table 4). Having health insurance and (marginally) being unstably housed were also associated with getting the CXR ever (ORs = 2.8 and 2.2, respectively), but not with getting the CXR within 7 or 30 days (Table 4).

## DISCUSSION

The specific sites and systems utilized for health care delivery to drug users play a critical role in determining adherence to therapy. Services delivered on site are frequently associated with greater adherence than those that require a referral to a separate setting. For example, methadone recipients randomly selected to receive general medical care or therapy for latent tuberculosis infection on site are more likely to receive care or complete treatment than those referred off site for the same intervention.<sup>13,14</sup> Adherence of IDUs recruited at SEPs to referral for off-site hepatitis B vaccination is enhanced using a monetary incentive,<sup>15</sup> but on-site vaccination at SEPs results in greater adherence.<sup>16</sup>

Co-locating TB screening and preventive therapy in drug treatment programs (e.g., methadone maintenance programs) significantly enhances drug users' adherence to TB services.<sup>14,17</sup> Strategies to conduct TB screening among the majority of drug users not in drug treatment at any given time include street-based recruitment and syringe exchange-based services.<sup>5-7,18,19</sup>

However, despite the advantages of on-site care when it is feasible, certain health care interventions may require referral from one site to another. Current standards require that those who are potential candidates for treatment of latent TB infection have a CXR performed to exclude active TB prior to instituting therapy.<sup>9</sup> Our data show that monetary incentives are highly effective in increasing adherence to referral for such CXRs to exclude active TB after syringe exchange-based tuberculin skin testing. The rate of adherence to referral for chest x-rays was 83% among drug users who received a \$25 incentive versus 34% for those who did not, and the time to obtaining a chest x-ray was shorter among those receiving the incentive (median 2 vs. 11 days). In multivariate analysis, the monetary incentive was the most potent independent predictor of adherence.

Incentives have been shown effective in improving return rates for PPD interpretation, compared with no incentive or with an educational intervention in randomized studies.<sup>19,20</sup> The choice of incentive (e.g., monetary incentives or food or

**TABLE 3. Factors associated with adherence within 7 days to referral for chest x-ray (CXR) from syringe exchange**

Factor	Did get CXR (N = 63),		Did not get CXR (N = 114),*		Univariate P value
	n	(%)	n	(%)	
Mean age, years	41.1		38.3		.04
Gender					
Male	38	(60)	79	(69)	.23
Female	25	(40)	35	(31)	
Race/ethnicity					
Non-Hispanic black	21	(33)	30	(26)	.47†
Non-Hispanic white	24	(38)	38	(33)	
Hispanic	14	(22)	33	(29)	
Other	4	(6)	13	(11)	
Received incentive	46	(73)	12	(11)	<.0001
No incentive	17	(27)	102	(89)	
Unstably housed	44	(70)	61	(54)	.03
Stable housing	19	(30)	53	(46)	
Employed	5	(8)	19	(17)	.10
Unemployed	58	(92)	95	(83)	
Health insurance	43	(68)	74	(65)	.65
No health insurance	20	(32)	40	(35)	
Education 12th grade or higher	37	(59)	72	(64)	.47
Education less than 12th grade	26	(41)	40	(35)	
Known HIV infected	8	(13)	21	(18)	.32
Not known HIV infected	55	(87)	93	(82)	
Alcohol to intoxication (past 6 months)					
Yes	28	(44)	49	(43)	.85
No	35	(56)	65	(57)	
Daily injection (past 6 months)					
Yes	20	(32)	55	(48)	.03
No	43	(68)	59	(52)	
Heroin use (past 6 months)					
Yes	41	(65)	73	(64)	.89
No	22	(35)	41	(36)	
Cocaine use (including crack) (past 6 months)					
Yes	39	(62)	73	(64)	.78
No	24	(38)	41	(36)	
Speedball use (past 6 months)					
Yes	17	(27)	49	(43)	.04
No	46	(73)	65	(57)	
Currently in drug treatment	29	(46)	46	(40)	.46
Not in drug treatment	34	(54)	68	(60)	

\*N's may vary slightly due to missing data.

†For the comparison of black, white, and Hispanic.

**TABLE 4. Independent predictors of adherence to referral for tuberculosis screening chest x-ray from syringe exchange: multivariate logistic regression**

Variable	Odds ratio (OR)	(95% confidence interval, CI)	<i>P</i>
Adherence within 7 days			
Incentive	22.9	(10.1–52.0)	<.0001
Adherence within 30 days			
Incentive	15.3	(6.9–33.6)	<.0001
Adherence ever			
Incentive	9.7	(4.3–21.9)	<.0001
Unstable housing	2.2	(1.05–4.6)	.04
Having insurance	2.8	(1.2–6.2)	.01

transportation vouchers) may have an impact on effectiveness, and the impact of monetary incentives may be proportional to the amount of the incentive.<sup>19,20</sup> In a randomized study of adherence to TB skin testing among street-recruited IDUs, a motivational education session did not improve adherence, while modest monetary incentives (\$5 or \$10) had a potent impact.<sup>19</sup> Adherence was 33% among those assigned to no intervention or motivational education only and was 85% and 92% among those receiving a \$5 or \$10 incentive, respectively (with or without education).<sup>19</sup>

The use of the incentive in this study was approved by an institutional review board, and potential participants were provided with information about the incentive during the informed consent process. Other investigators have discussed the ethics and other implications of the use of incentives, including financial incentives, in various clinical and research settings.<sup>21–24</sup>

Whether incentives used in the context of one intervention might create an expectation of incentives in other contexts is unknown. However, it has been proposed that incentives be considered ethical if they constitute a persuasive rather than coercive form of influence, if the offer of the incentive is welcomed by the individual receiving the offer, and if the incentive constitutes a “substantially non-controlling influence,” leaving the individual the autonomy to decline the intervention for which the incentive is offered.<sup>21–24</sup> The modest amount of the incentive offered and the fact that 21% did not adhere even when it was offered suggest that it did in fact constitute a persuasive rather coercive influence consistent with individual autonomy.

Interventions such as incentives, however, do pose significant program costs. Consequently, acceptance of incentives as a routine part of an ongoing clinical or public health program would require demonstration that the incentive promoted improved adherence, and that the benefits derived from such improved adherence would plausibly or demonstrably offset the cost of the incentive program or be “worth” the additional expense. Previous data from a cost-effectiveness model, which used real observed program adherence rates (including 34% adherence to CXR referral), demonstrated that, for 1,000 patients offered screening, directly observed preventive therapy for drug users on site at a syringe exchange would yield a net cost saving of \$123,081 in future TB treatment costs averted.<sup>11</sup>

The previous cost modeling<sup>11</sup> also demonstrated that if a \$25 incentive per



person increased CXR adherence to 100%, the net cost savings of TB treatment costs averted would increase to \$414,856, with a cost savings per case averted of \$10,211. The model also showed that even if the incentive increased CXR adherence from the base rate (34%) to just 50%, the net savings would be \$170,054, with a cost savings of \$12,391 per case averted.<sup>11</sup> In the current study, a \$25 incentive increased adherence to 83%, indicating that the program using monetary incentives yielded a net cost savings compared with the program design without the monetary incentives. The cost saving per case averted would fall in the range between the amounts identified in the 50% and 100% models (i.e., between \$10,211 and \$12,391), and the net cost savings as a result of the program would also fall between the savings observed in the 50% and 100% models (i.e., between \$170,054 and \$414,856).<sup>11</sup>

In conclusion, the current data demonstrate that monetary incentives are highly effective at increasing adherence in this setting and therefore are justifiable on a cost basis. When health care interventions for drug users require referral off site, monetary incentives may be particularly valuable in promoting adherence.

#### ACKNOWLEDGEMENT

This work was supported by the National Institute of Drug Abuse (RO1-DA9005). We gratefully acknowledge the support and assistance of the syringe-exchange participants and syringe-exchange program staff, particularly Drew Kramer and Mark Gerse; the efforts of Wilson Lugo and Irene Caraballo; and invaluable assistance of Laura Liberman.

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