Willingness to pay for drug rehabilitation: Implications for cost recovery

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Abstract

Objectives: This study estimates the value that clients place on methadone maintenance and how this value varies with the effectiveness of treatment and availability of case management. We provide the first estimate of the price elasticity of the demand for drug treatment.

Methods: We interviewed 241 heroin users who had been referred to, but had not yet entered, methadone maintenance treatment in Baltimore, Maryland. We asked each subject to state a preference among three hypothetical treatment programs that varied across three domains: weekly fee paid by the client out-of-pocket ($5–$100), presence/absence of case management, and time spent heroin-free (3–24 months). Each subject was asked to complete 18 orthogonal comparisons. Subsequently each subject was asked if they likely would enroll in their preferred choice among the set of three. We computed the expected willingness to pay (WTP) as the probability of enrollment times the fee considered in each choice considered from a multivariate logistic model that controlled for product attributes. We also estimated the price elasticity of demand.

Results: The median expected fee subjects were willing to pay for a program that offered 3 months of heroin-free time was $7.30 per week, rising to $17.11 per week for programs that offered 24 months of heroin-free time. The availability of case management increased median WTP by $5.64 per week. The price elasticity was −0.39 (S.E. 0.042).

Conclusions: Clients will pay more for higher rates of treatment success and for the presence of case management. Clients are willing to pay for drug treatment but the median willingness to pay falls short of the estimated program costs of $82 per week. Thus a combined approach of user fees and subsidization may be the optimal financing strategy for the drug treatment system.

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Keywords: Willingness to pay; Addiction; Heroin; Methadone; Drug treatment

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1. Introduction

The economic burden of illicit drug use was estimated at $143 billion in 1998 ($160 billion in 2003) (Cartwright and Solano, 2003; Harwood et al., 1998). Contributing to this problem are an estimated 119,000 heroin users, 2.3 million cocaine users, and 4.7 million Americans who used pain killers illicitly in 2003 (Substance Abuse and Mental Health Services Administration 2004). Social costs are estimated to average $22,000 annually per illicit drug user ($160 billion/7.3 million users) (Cartwright and Solano, 2003). An estimated 7.3 million illicit drug users could be classified as needing specialty treatment for their drug problem (Substance Abuse and Mental Health Services Administration 2004). Of these, 1.5 million (20.8%) were estimated to perceive a need for drug abuse treatment. However, only 1.1 million (15%) illicit drug users actually received treatment for illicit drugs. (Substance Abuse and Mental Health Services Administration 2004). The most recent estimates show that in the US, 49% of outpatient methadone treatment is paid for with public funds (e.g. block grants, Medicaid, and other public funds) and 39% is paid for out-of-pocket (Substance Abuse and Mental Health Services Administration (SAMHSA) 2003).

That only 21% of those with illicit drug problems recognized a need for treatment and only 15% actually obtained treatment is the basis of a policy dilemma. Treatment could help to reduce the external costs that illicit drug users impose on society via crime, interpersonal violence, spread of disease (e.g. HIV/AIDS and TB), and the socially insured health harms which drug users suffer. For illicit drug users who recognize a need for treatment, subsidies for treatment can be justified on the basis of the large social externalities caused by illicit drug use. Even some libertarians could justify a subsidy for drug users (Thaler and Sunstein, 2003). Treatment as a method to reduce the externality of the costs of prison for drug users is the basis of Proposition 36 in California. Proposition 36 was passed in 2000 to allow those convicted of 1st and 2nd time nonviolent, simple drug possession to receive drug treatment instead of incarceration (Drug Policy Alliance, 2007). Drug users in many other states now enter treatment through coercion from the criminal justice system.

Methadone maintenance treatment is estimated to cost $82 per week and many in methadone stay in treatment for months (Roebuck et al., 2003). However, studies have shown that treatment is cost effective (Cartwright and Kaple, 2000; Jofre-Bonet and Sindelar, 2001; McCollister and French, 2003). Thus, it is in society’s interest to ensure that those who desire treatment can obtain it and can receive effective, high quality care. Further, longer lengths of stay have been shown to produce greater benefits (Zarkin et al., 2002). Despite the compelling public interest, it is thought that there is inadequate public funding to provide the good-quality, accessible care that would benefit not only the drug users but also society at large. One way to expand the system would be to use price discrimination to provide revenue to clinics by encouraging individuals who are willing to pay, to do so. Some price discrimination already occurs and out-of-pocket payments are already a part of the revenue flow of clinics. However, this price discrimination should be optimized because poor execution could result in fewer people obtaining treatment. Thus our effort to provide estimates of the elasticity of demand can aid efforts to maximize revenue while still maintaining the demand for treatment.

A rational approach to budgeting treatment subsidies would not require underwriting 100% of treatment for every client. One could use a method of Ramsey pricing to base the subsidy for various drug users on their elasticity of demand (Baumol and Bradford, 1970). Ramsey pricing would set up a regime of price discrimination that maximizes revenue to the drug treatment system by charging more for those with higher demand and less for those with lower demand. To optimize a Ramsey pricing system in drug treatment services, information on the price elasticity and how it varies by program and user characteristics would be needed. However, information on price elasticity for the demand for treatment for illicit drug use is not currently available (Cartwright and Solano, 2003), but see (Borisova and Goodman, 2003) on travel time elasticity.

The objective of this paper is to inform cost-sharing strategies between users and payers of methadone maintenance treatment. In Section 1, we develop a welfare economics model of the optimal subsidy that a social planner would pay to underwrite the drug treatment for an illicit drug user. Section 2 describes the primary data collected in Baltimore during 2002–2003 as part of a conjoint analysis to estimate the demand for drug rehabilitation and leads to Section 3 where we describe the methods used to analyze the data. In Section 4 we present our results. Finally in Section 5 we describe limitations of the analysis and discuss implications for policy.

2. A model of the optimal subsidy

Suppose there is a population of addicts and taxpayers who live for multiple identical periods, but we will only consider the problem they face in one representative period. There are \(N_A\) addicts who pay no taxes and \(N_T\) taxpayers...
who pay a flat tax, $\tau$. We assume $N^T > N^A$ and define the ratio of addicts to taxpayers as: $\theta = (N^A/N^T)$. Each addict derives an identical income, $y^A$ by inflicting property losses on the taxpayers. Each taxpayer has income $y^T$ and $y^T > y^A$. The average property loss per taxpayer is $(y^A N^A/N^T)$ or $\theta y^A$. The addicts have a demand for a medical treatment, $m$, that stops their addiction for a period of time, converting them into taxpayers for the duration of one period. This medical treatment can be thought of as being delivered in doses that last for a unit of time, for example a week or month of treatment. If purchased, medical treatment, $m$, will be effective for the entire treatment period. The choice being modeled is thus a dichotomous choice variable-to enroll for a period or not. The length of time the treatment will last is exogenous to the model.\footnote{We focus on dichotomous treatment entry, both because the empirical data concern a choice to enter treatment, and because few addicts consciously choose to attain small spans of time free of their addiction. At treatment entry, addicts declare an intention of lifelong freedom from their addiction. Nobody declares a plan to fail treatment two and a half months later.}

If $m = 0$, the addict has not bought treatment, and if $m = 1$, the patient has bought treatment for the entire period. The medical treatment is purchased for a single lump sum payment, $p$ that entitles the patient to receive a complete series of visits and regular administration of pharmaceuticals as needed for the period. For convenience we define the length of one period to equal the duration of effects of the treatment. At the end of the period the addiction will return unless the treatment is repeated and treatment will have the same effectiveness in subsequent periods. The treatment is available at price, $p$ per period. There is no other way for an addict to change their behavior in a period besides purchasing the treatment. We now consider a social planner who wants to maximize social welfare by devoting all of the tax towards a Pigouvian subsidy, $s$, applied to the price of the treatment. The social planner’s budget constraint is $N^T \tau = mN^A s$, which implies that $\tau = \theta ms$. With the simplification that each member within the two subpopulations is identical, an egalitarian social planner weighs the utility of each member of the population equally, so the social planner’s problem is to choose “s” in order to maximize $W$ as follows:

$$W = N^A \times U^A(m, c^A) + N^T \times U^T(c^T)$$  (1)

Normalizing the price of consumption $c$ to be equal to 1, the respective budget constraints can be written as:

$$y^A = c^A + (p - s)m$$  \hspace{1cm} (2)

$$y^T = c^T + \tau + \theta y^A$$  \hspace{1cm} (3)

Inserting the budget constraints and the tax identity $\tau = \theta ms$ into (1) we can recast the social welfare function as:

$$W = N^A \times [U^A(m_i, [y^A - (p - s)m_i])] + N^T \times [U^T(y^T - \theta ms - \theta y^A)]$$  (4)

Define the addict’s marginal rate of substitution between $m$ and $c$ as

$$\psi = \frac{(dU^A/dm^A)}{(dU^A/dc^A)}$$

Define the social rate of substitution between addict consumption and taxpayer consumption as

$$\varphi = \frac{(dU^T/dc^T)}{(dU^A/dc^A)}$$

Assuming that $U'(c) > 0$ and $U''(c) < 0$, would ordinarily ensure that $0 < (dU^T/dc^T) < (dU^A/dc^A)$ and thus that $0 < \varphi < 1$ because of the higher income and lower marginal utility of taxpayers’ consumption. This would mean that redistribution of one unit of consumption from a taxpayer to an addict creates a utility gain for the addict that outweighs the utility loss for the taxpayer. It is possible that addiction could also lower the marginal utility of consumption because substance use effectively satiates the pleasure centers in the brain. We simply stipulate that in general, $(dU^T/dc^T) \neq (dU^A/dc^A)$ and consider the two possibilities of $\varphi < 1$ and $\varphi > 1$.

The first order condition that defines the optimal subsidy $s^\ast$ can be written as

$$s^\ast = \frac{\psi}{(\varphi - 1)} + \frac{p(1 - \varphi - \varepsilon_p)}{(\varphi - 1)\varepsilon_p}$$  \hspace{1cm} (5)

(See Appendix A for derivation.)
Furthermore as shown in Appendix A,

\[
\frac{ds}{de} = \frac{p}{e^2_p}
\]  

(6)

So that the subsidy declines as the addict’s demand for treatment becomes more elastic.

Heterogeneity in the demand for treatment suggests offering different subsidies for different addicts, if discrimination is feasible. By extension, if addicts’ preferences were unstable over time, the optimal subsidy would be different for an addict at different times. In the face of heterogeneity, targeting different subsidies to different individuals is known to improve the efficiency of public programs (Shephard and Zeckhauser, 1982). As pointed out by Schuck and Zeckhauser, targeting could help to divert funds away from individuals who are unlikely to benefit, or who may benefit without help (Schuck and Zeckhauser, 2005).

Subsidies would be zero for addicts with high willingness to pay for treatment and even perhaps negative (i.e. a surcharge) for addicts with highest willingness to pay. In contrast, addicts with no demand for treatment might respond to subsidies whose value exceeded the fee for treatment, essentially paying them to remain in treatment. Experience has accumulated with positive subsidies whose value exceeds the fee for treatment—effectively paying a subset of addicts to abstain from drug use and remain in treatment (Peirce et al., 2006).

As can be shown, the optimal subsidy would be 0 when

\[
\psi = \frac{p(\varphi - 1 + \varepsilon_p)}{\varepsilon_p}
\]

For the typical case where \(0 < \varphi < 1\) and \(\varepsilon_p < -1\), the point at which the optimal subsidy is zero occurs at non-negative values of marginal rate of substitution, \(\psi\), when addicts have a high willingness to pay for their own treatment. The optimal subsidy can become negative (e.g. a surtax on treatment) if addicts have very high willingness to pay for treatment \(\psi \gg 0\) or if it is socially optimal to redistribute wealth from addicts to taxpayers because \(\varphi \gg 1\). The optimal subsidy is negative whenever \(\psi > [p(1 - \varphi - \varepsilon_p)]/\varepsilon_p\). One can show that the subsidy would be positive and in excess of the price of treatment if \(p < (\psi \varepsilon_p/1 - \varphi - \varepsilon_p)\). The condition for the subsidy to exceed price can be met when the addict has a negative marginal rate of substitution, \(\psi\), in effect, deriving disutility from treatment.

The foregoing considerations suggest that the optimal subsidy would differ for addicts whose elasticity of demand or utility/disutility from treatment differed. As is well-known both from field experience with addicts and from economic theory (Dockner and Feichtinger, 1993), an individual addict’s demand for treatment waxes and wanes over time. If each addict had time varying preferences so that their demand for treatment exhibited regular peaks and troughs, the optimal subsidy would vary within a single addict as their willingness to comply with treatment waxed and waned. As Eq. (6) indicates, the optimal subsidy would have to keep pace with \(1/\varepsilon^2\). According to our theory, measures of addicts’ price elasticity of demand for drug rehabilitation form the foundation for policies that hope to subsidize lapses and insufficiencies in demand. Furthermore the policy response hinges on how homogeneous/heterogeneous the population of addicts in a community is. We turn now to discuss an initial set of measurements of addicts’ price elasticity.

3. Study population

Between January 2002 and January 2003, 247 heroin injection drug users (IDUs) who requested and were granted an available methadone maintenance treatment slot by the Needle Exchange Program (NEP) program staff were invited to participate in a randomized, controlled trial of strengths-based case management (SBCM) vs. usual methadone maintenance. The participation rate among those invited to participate was approximately 99.2% (245 of 247). Within 7 days of the initial interview, 52% of the participants followed through and actually enrolled into the treatment slot to which they were assigned.

Details of this randomized trial are available elsewhere (Strathdee et al., 2006). For IDUs who agreed to enter the trial, a signed consent was obtained and a baseline interview was conducted prior to the treatment intake appointment. This study was approved by the Johns Hopkins Bloomberg School of Public Health Committee on Human Research.

To develop the survey instrument, we held key informant interviews with drug rehabilitation case managers and their administrator. These revealed that price, duration of effect and the availability of case management would be the most salient program features to inquire about. We studied five different prices ($5, $25, $40, $60, and $100 per week); two different availabilities of case management (available or not); and three different durations of treatment effect (3, 6, or
24 months of freedom from heroin). The treatment effect durations were developed based on reports of retention rates in Baltimore that ranged from medians of 3–6 months at fixed site methadone treatment facilities (Greenfield et al., 1996). Since 20% of patients remained enrolled at 24 months, we set that as the upper bound. While time in treatment does not mean abstention from drug use, it serves as a reasonable basis for these alternative hypothetical effectiveness rates. In order to cover a complete and orthogonal set of these product features with minimal respondent burden we consulted Sawtooth software (Louviere, 1988; Sawtooth Software Inc., 1999), and concluded that two parallel sets of 18 sequential choices among were necessary. Subjects were randomized so that half of them saw each set. Each of the 18 choices imposed a new array of three hypothetical methadone maintenance program descriptions listing the price, duration of effect, and presence of case management (see Fig. 1). All subjects were told to expect that they would have to pay for the hypothetical program themselves because insurance would not reimburse them for the treatment. Cards were randomized so that each of the five prices was faced in about one out of five encounters. Each of the two case-management choices was faced in roughly half and each of the three effect durations face in 1/3 of product encounters. After viewing the three options, subjects were asked, “From these three cards, which program would you PREFER? The subsequent question was “Would you actually enroll in this program?”.

4. Statistical analysis

The evaluation of each of these 54 drug treatment programs (18 sets \(\times\) 3 programs per set) always occurred in the context of exactly 2 competitor programs. The respondents indicated both which program they preferred and, in a separate question, whether or not they would pay for the preferred program. This analysis studies the responses to the second question—“whether they would pay”.

The dependent variable in our model is a binary variable indicating whether the respondent would pay out-of-pocket to enter treatment with the preferred set of characteristics out of each set of the three alternatives. The independent variables are the attributes (price, duration, and heroin-free time) of the programs considered and the baseline personal characteristics (e.g. socio-economic-demographic as well as addiction severity indices). The generalized linear model which we studied takes the form

\[
E(Y) = g^{-1}(\beta_P' P_k + \beta_{D}^{\prime} \text{Dur}_k + \beta_S' S_k + \beta_A' X) + (\mu_{\text{Question}} + \mu_{\text{Subject}} + \epsilon)
\]  

(7)
where $g^{-1}(\cdot)$ is an inverse logistic link function and $(μ_{\text{Question}} + μ_{\text{Subject}})$ are separate random effects associated with each of the 18 questions and each of the 245 subjects. $Y$ is an indicator of whether the subject would pay for the program, $k$ subscripts the programs own attributes and the attributes of two other competing programs that could be chosen instead. Thus $P_k$ is a vector of the program’s own price and the prices of the two competing programs appearing within each set of the 18 cardsets. $\text{Dur}_k$ and $\text{Sk}$ are respectively, vectors of “own” and two competing durations of freedom from heroin and “own” and two competing indicators of availability of case management. The vector $X$ represents individual respondent characteristics that might influence choice.

We first estimated this model using maximum likelihood methods based on the “gllam” program in Stata™ (Rabe-Hesketh and Skrondal, 2002). We subsequently ran simple logit models without any random effects specification. The increased efficiency of the computationally intensive maximum likelihood approach led to smaller standard errors but coefficient estimates that were very close to the simple logit estimates. The significance of the coefficients was the same for the random effects and simple logit models. We used the “mfx compute, eyex” command in Stata 8.0 to convert the coefficients into marginal effects that could be interpreted as own price and cross price elasticities. These arc elasticities have the conventional interpretation: the percentage increase in quantity demanded due to a percentage decrease in price. The elasticity is only valid around the means of all of the covariates in the sample. It reflects the marginal response to marginal changes in the attributes of one program in an environment where there are two alternatives each with the mean price, duration, and case management availability of the products on the 18 sets of programs. The marginal effects also reflect the mean income and perceived risk characteristics of the sample.

5. Results

For this sample of heroin users, the mean daily expenditure on heroin was $64.63 (S.D. $47.31), excluding two outliers who reported spending over $1000 per day on heroin. Table 1 shows the basic descriptive data from the sample. The sample had a majority of non-Hispanic African Americans and males. Self-reported income had a mean of $1202, a median $855, and a maximum of $8000 per month. Only 8.5% of respondents were employed. Over 38% of respondents reported deriving income from illegal sources; there may be underreporting of both illegal and under-the-table income.

Respondents were asked to express a preference for one of the three hypothetical treatment programs in each of the 18 card sets. Out of the 245 subjects, there were five refusals to answer preference questions leading to the collection of preference statements for $18 \times 240$ sets of three goods. After indicating which of the three was preferred, respondents
were asked if they would pay the stipulated fee to enroll. The data describe the outcomes for 18 cardsets × 3 programs per cardset × 240 subjects = 12,960 non-independent opportunities to express a willingness to purchase and/or a preference.

Figs. 2 and 3 visually summarize the preference data. Fig. 2 shows that the subjects intended to purchase the lowest priced ($5.00 per week) program 63% of the time when it was coupled with the promise of 24 months free of heroin. This willingness to purchase at $5.00 fell to 40% with only 6 months free of heroin and to 36% if only 3 months. Fig. 2 assesses face validity by demonstrating a responsiveness to scope of benefits. The proportion intending to enroll decreased systematically with price for a given time free of heroin. That is, the slopes are downward sloping and increase by time heroin-free. Similarly, Fig. 3 demonstrates that the presence of case management increases the probability of enrolling by about 10–20%, holding the fee constant. The demand curves for drug rehabilitation shown in Figs. 2 and 3 show convexity consistent with diminishing marginal utility (Hicks, 1975). However, this feature is somewhat exaggerated because the demand curves are perfectly inelastic after the price reaches $60 per week. This may be an artifact due to a minority of respondents who were holdouts and due to the top censoring of price.

Figs. 2 and 3 can be used to calculate a summary measure of willingness to pay using “the area under each curve” and the data on the predicted probabilities of purchase. This can be done using a logit model of Eq. (7) (excluding the “X” variables) to impute the probability of purchase (\( \hat{\pi}_i \) for the “ith” respondent), for each of the 12,960 respondent-product pairs and data on the prices and other product attributes. The area under each of the curves in Figs. 2 and 3 are \( \sum_i (\hat{\pi}_i \times \text{Price}_i) \) where \( \text{Price}_i \) is the price of the “ith” encountered product. One could interpret \( (\hat{\pi}_i \times \text{Price}_i) \) as the statistically expected revenue from the “ith” person-product encounter and offer summary measures of this distribution to convey willingness to pay of the sample. The skewness of the distribution makes the median a better summary measure than the mean (Mitchell and Carson, 1989). If a drug rehabilitation program practiced perfect price discrimination in a range between $5 and $100, the median expected revenue per client (corresponding to area under the curve in Fig. 2)
would be $17.11, $8.42, and $7.39 for programs that offered 24, 6, and 3 months of heroin-free time. For Fig. 3, the corresponding summary measures are $13.05 and $7.40 for programs that do and do not offer case management, respectively. However, these numbers could be underestimates of the true WTP as our five price points do not exhaust the full range of demand. As can be seen in Fig. 2, there remain as many as 40% of subjects who say they would purchase treatment at $100 per week. If these percentages remain high at prices of $150, $200, or even $250, there could be substantial private willingness to pay that is unmeasured in our model.

In Table 2 we display the results of five different multivariate models of the willingness to pay using logistic regression. In separate analyses (not shown) a dummy variable indicating having preferred dominated choices had no effect on the probability of declaring a willingness to pay. To maximize the power of the sample, all of the subjects were retained for subsequent models and background variables were retained as covariates.

Product attributes were powerful determinants of the decision to purchase. In contrast, only a few personal attributes were significant. The principal socio-demographic background variables associated with WTP were co-residence with females or with parents, which increased WTP and frequent religious service attendance which decreased WTP. A separate study of the data from this trial confirmed that living with a sexual partner increased threefold the odds of actually entering treatment (Lloyd et al., 2005). It may be that the highly religious may see their religious participation as a substitute for opioid agonist therapy with methadone.2 The components of the addiction severity index had opposing effects. The psychiatric subscale was associated with increased willingness to pay while the medical and drug use subscales were associated with decreased willingness to pay.

Based on model 1 of Table 2, the price elasticity of demand for drug treatment was estimated at −0.39 (95% CI: −0.47 to −0.31) based on a computation of marginal effects with the mfx command. This elasticity was estimated at the sample mean of the product attributes implying a cash price of $48 per week of treatment, a mean stipulated treatment outcome of 10 months of freedom from heroin, and a 49% probability that there would be case-management services available. Table 2 also shows no income effects on demand for rehabilitation, but this should be interpreted in light of the difficulty of measuring income in a population with very little regular employment and who may have had illicit sources of income.

We believe that we are the first to offer an estimate of the price elasticity of demand for substance abuse. Thus we cannot compare our results to other literature. However, we can compare our estimated price elasticity to those found in mental health, which may be the closest set of comparisons. Haas-Wilson et al. estimate the price elasticity of demand for outpatient mental health services to be −0.34 (Haas-Wilson et al., 1989). Manning et al. (1987) find a price elasticity of −2 (Manning et al., 1987) and Keeler et al. estimate it to be from −0.59 to −0.79 (Keeler et al., 1986). Ellis and McGuire suggest an demand elasticity ranging from −0.3 to −0.42 (Ellis and McGuire, 1986). Thus, our estimates are in the range of those found for mental health services.

In order to validate our estimates of willingness to pay we tested the predictive value of each participant’s inherent willingness to pay for treatment against whether they actually enrolled and whether they remained in treatment longer. We calculated the random effect for each subject (μSubject in Eq. (7)) and found that it had a mean of zero and a standard deviation of 0.211. The random effect can be interpreted as an individual-specific residual tendency to respond “Yes” when asked about enrolling in drug rehabilitation in the near future. We formed quintiles based on the random effect and found that in each of the lowest two quintiles 48% of subjects enrolled. In the middle and fourth quintile 54% and 60% enrolled, respectively. However in the top quintile only 44% enrolled over the next 7 days at this clinic. Except for the top quintile, there was a monotonic positive correlation between the unobservable propensity of participants to say they were willing to pay to enroll in treatment and the probability of actually enrolling. Paradoxically, the top quintile which should have the highest likelihood of enrolling, had the lowest. This pattern was similar both in the sample of subjects who had ever chosen a “dominated” option and the sample who had never chosen a “dominated” option.

By construction, this random effect is orthogonal to all of the product attributes and all of the observable socio-economic-demographic data used to estimate WTP so it is impossible to examine covariates that could explain the anomalous behavior of the highest quintile. In order to assess whether the inclusion of these top quintile individuals was biasing our estimates of willingness to pay we reran the logistic regression models with these top quintile individuals excluded and derived estimates of the coefficients on prices and product attributes that never differed by more than 0.05 points from the estimates shown in Table 2.

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2 Marx may have had a different phenomenon in mind when he wrote that “Religion . . . is the opiate of the people (Marx, 1994)”. 
Table 2
Logistic model coefficients of Pr(respondent says they would enroll in methadone treatment)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of the program under consideration</td>
<td>$-0.013 (-18.13)^{***}$</td>
<td>$-0.014 (-8.43)^{***}$</td>
<td>$-0.013 (-7.97)^{***}$</td>
<td>$-0.015 (-8.50)^{***}$</td>
<td>$-0.014 (-8.17)^{***}$</td>
</tr>
<tr>
<td>Availability of case management in the program under consideration</td>
<td>$0.70 (13.04)^{***}$</td>
<td>$0.68 (5.90)^{***}$</td>
<td>$0.71 (7.41)^{***}$</td>
<td>$0.69 (6.01)^{***}$</td>
<td>$0.66 (5.69)^{***}$</td>
</tr>
<tr>
<td>Time free of heroin in the program under consideration</td>
<td>$0.048 (15.03)^{***}$</td>
<td>$0.045 (11.27)^{***}$</td>
<td>$0.048 (12.81)^{***}$</td>
<td>$0.045 (11.23)^{***}$</td>
<td>$0.044 (10.54)^{***}$</td>
</tr>
<tr>
<td>Price of the first alternative</td>
<td>$0.0046 (8.27)^{***}$</td>
<td>$0.0050 (4.22)^{***}$</td>
<td>$0.0050 (5.08)^{***}$</td>
<td>$0.0050 (4.08)^{***}$</td>
<td>$0.0050 (4.00)^{***}$</td>
</tr>
<tr>
<td>Availability of case management in the first alternative</td>
<td>$-0.25 (-4.87)^{***}$</td>
<td>$-0.23 (-3.05)^{***}$</td>
<td>$-0.25 (-3.19)^{***}$</td>
<td>$-0.23 (-3.08)^{***}$</td>
<td>$-0.24 (-3.14)^{***}$</td>
</tr>
<tr>
<td>Time free of heroin in the first alternative</td>
<td>$-0.021 (-6.11)^{***}$</td>
<td>$-0.026 (-5.19)^{***}$</td>
<td>$-0.020 (-4.09)^{***}$</td>
<td>$-0.026 (-5.20)^{***}$</td>
<td>$-0.024 (-4.69)^{***}$</td>
</tr>
<tr>
<td>Time free of heroin in the second alternative</td>
<td>$-0.033 (-9.56)^{***}$</td>
<td>$-0.039 (-7.43)^{***}$</td>
<td>$-0.032 (-6.70)^{***}$</td>
<td>$-0.039 (-7.64)^{***}$</td>
<td>$-0.037 (-7.13)^{***}$</td>
</tr>
<tr>
<td>Maried</td>
<td>0.068 (0.96)</td>
<td>0.10 (1.17)</td>
<td>0.066 (0.82)</td>
<td>0.12 (1.43)</td>
<td>0.12 (1.43)</td>
</tr>
<tr>
<td>Miles from their zip code to treatment referral site</td>
<td>0.0020 (0.61)</td>
<td>0.0030 (0.65)</td>
<td>0.0030 (0.69)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Non-self HH members female</td>
<td>0.152 (2.19)^{**}</td>
<td>0.174 (2.66)^{***}</td>
<td>0.177 (2.43)^{**}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attends svc &lt;1/month</td>
<td>0.111 (1.32)</td>
<td>0.097 (1.1)</td>
<td>0.117 (1.31)</td>
<td></td>
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</tr>
<tr>
<td>Attends svc 2–3/month</td>
<td>0.010 (0.17)</td>
<td>0.017 (0.32)</td>
<td>0.006 (0.11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attends svc weekly</td>
<td>0.014 (0.18)</td>
<td>0.007 (0.08)</td>
<td>0.022 (0.28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attends svc &gt;1/wk</td>
<td>$-0.646 (-2.31)^{**}$</td>
<td>$-0.634 (-2.26)^{**}$</td>
<td>$-0.578 (-2.05)^{**}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives in other’s house/apt</td>
<td>0.043 (0.59)</td>
<td>0.042 (0.56)</td>
<td>0.027 (0.33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any support from illegal</td>
<td>$-0.004 (-1.71)$</td>
<td>$-0.003 (-1.72)$</td>
<td>$-0.003 (-1.49)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Income per month</td>
<td>0.000042 (0.155)</td>
<td>-0.000039 (0.127)</td>
<td>-0.000047 (0.157)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives with parents</td>
<td>$0.242 (1.78)^{**}$</td>
<td>0.241 (1.76)^{**}</td>
<td>0.272 (2.02)^{**}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychiatric Severity ASI Subscale</td>
<td>$-0.254 (1.99)^{**}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Severity ASI Subscale</td>
<td>$-0.201 (-2.33)^{**}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Severity ASI Subscale</td>
<td>$-0.531 (-1.57)^{**}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$-0.984 (-44.98)^{***}$</td>
<td>$-0.973 (-8.71)^{***}$</td>
<td>$-0.809 (-4.75)^{***}$</td>
<td>$-0.935 (-3.93)^{***}$</td>
<td>$-0.722 (-2.67)^{***}$</td>
</tr>
<tr>
<td>Observations</td>
<td>12960</td>
<td>9936</td>
<td>12852</td>
<td>9882</td>
<td>9342</td>
</tr>
</tbody>
</table>

Robust $z$-statistics in parentheses. Models 3, 4, and 5 also included, age, gender, race, and ethnicity, all of which were statistically insignificant.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.
For those who did enroll, this latent measure of individual WTP did predict higher retention. Based on a Cox regression the hazard rate for termination was 89% ($p = 0.12$) lower for individuals with a 1 standard deviation increase in latent WTP. When the Cox regression was repeated with the top quintile of WTP excluded the hazard rate was of similar magnitude and the $p$-value fell to 0.07.

6. Discussion

Our study revealed that the subset of drug addicts who have expressed non-zero interest in having their addiction treated have a relatively inelastic demand for methadone maintenance treatment with an arc price elasticity of $-0.39$. This is the first estimate of price elasticity for drug treatment in the literature. This estimate of elasticity is contingent on the setting of this study and the set of hypothetical program parameters, as well as the characteristics of the sample population. Thus, the estimate of the price elasticity is not as generalizable as we would like. However, as the first estimate, we hope that it paves the way for future research. Revealed preference data from price experiments in drug treatment clinics are difficult to obtain. No secondary data sets provide the information that would be needed to estimate price elasticities. Knowledge of the price elasticity is important as there are many applications to policy issues. A prior study (Borisova and Goodman, 2003) showed that addicts have a willingness to pay for reductions in travel time to methadone maintenance, but did not address the price elasticity of demand for treatment.

Our study also demonstrated a positive willingness to pay more for case management and for longer treatment durations. This suggests that higher quality programs could capture more cost sharing by clients. However, the willingness to pay by clients is not enough to fully offset the salary of case managers.

According to our estimates, a drug rehabilitation system that could maintain a discriminatory pricing regimen would obtain a median expected revenue per addict of $7.40–$17.11 per week with a clientele similar to our sample of individuals expressing an interest in enrolling in drug rehab. This would not cover the cost of outpatient methadone maintenance programs which average $82 per week, with the least cost program at $42 per week (Roebuck et al., 2003). Governments, which pay for a majority of all substance abuse treatment, and individuals realize that there are social gains to subsidizing treatment. The willingness of ordinary citizens to provide public support has been studied using contingent valuation survey methods in mall-intercept samples from Brooklyn, NY and the Triad area of North Carolina where investigators derived a mean willingness to pay of $37 per payer towards expansion of drug treatment programs (counseling based, not methadone) to treat an additional 100–500 patients per year (Zarkin et al., 2000). Our findings underscore the diversity of preferences for treatment among addicts. As seen in the figures, the willingness to pay for treatment spans a range from $5 to $100 among addicts who have expressed an interest in obtaining treatment. We already know that roughly 80% of users of illicit substances do not perceive a need for treatment and have willingness to pay of $0 or less. The heterogeneity in addicts’ preferences for treatment revealed in this study and others dictates a flexibility in the way different addicts are targeted with incentives. As suggested by our theory, those with positive marginal utility of treatment would merit a subsidy that declines as the addict’s price elasticity of demand for treatment approaches zero. However, the optimal subsidy for addicts with negative marginal utility from entering treatment is likely to exceed the price of treatment. Contingency management is a treatment method that pays drug users in treatment to abstain from using drugs and also for abstaining longer while in treatment. This paves the way for positive payment to enter and stay in treatment\(^3\) (Peirce et al., 2006; Petry et al., 2005; Sindelar et al., 2007).

6.1. Validity checks on the results

One of the threats to validity of contingent valuation methods is the concern that respondents may not have conceptualized the hypothetical products exactly as they were specified. They may rely on their own personal experiences instead. Substance abuse is a chronic, cyclical problem making relapse and reentry into treatment the norm. Many who are entering treatment have been in treatment before providing personal experience that they drew on when responding

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\(^3\) Paying vulnerable populations for pro-social behavior is currently being introduced in a variety of settings. Mayor Bloomberg has recently announced such a plan in New York City. This program is funded by private funds, not the government. For more information see http://www.msnbc.msn.com/id/20439282/site/newsweek/.
to the survey. We suggest that to the extent that they have been in treatment before and are again in need of treatment, they may discount the stated lengths of drug-free time. To the extent that they use their own beliefs of less effective treatment, they may be under-reporting their willingness to pay.

Our results have face validity in that increments in desirable program attributes such as availability of case management and the program’s stipulated time free from heroin dependence led to increments in demand. Also, we were able to provide stronger validation through revealed preference. The 245 respondents in our trial were randomized after our survey to treatment with case management (strengths-based case management) or without case management. Assignment was revealed right after the WTP survey was conducted and subjects who were assigned to SBCM immediately received an initial session with a case manager. We subsequently observed whether the client actually followed through with the referral and later enrolled in the assigned treatment program by record linkage with the Baltimore Substance Abuse System. As reported in a separate paper, actual enrollment rates in the study were 12.8 percentage points higher for clients randomized to case management which is similar to the difference between the demand curves for case management in the two curves shown in Fig. 3 (Strathdee et al., 2006).

Because we measured both stated willingness to enroll and actual enrollment we were able to assess the validity of the stated intentions. The measure of an individual’s inherent willingness to enroll based on the random effect was predictive of a modest improvement in treatment retention, although the statistical significance of this finding is marginal. For 4/5 of the sample the higher the latent predisposition to state that one would pay money to enroll in drug treatment the higher was the enrollment probability. It is puzzling then that the top quintile, having exhibited the highest latent WTP, had the lowest enrollment rate.

### 6.2. Policy implications

The key policy issue is how to increase the number of heroin users who obtain treatment. The supply of treatment sites is so limited that it cannot meet current demand in many geographic locations. However, only a small percentage of those with substance abuse problems get treatment. In this study, only half of those who expressed interest in treatment and were offered free treatment actually enrolled. Both supply and demand should be increased to reduce the toll of drug use on society. Our findings suggest that an optimal price discrimination policy might be able to increase the number treated by financing the supply of additional slots. If strategically implemented, differential pricing could be imposed without lowering the demand. Positive payments might be used to attract some into treatment. Many of those in treatment currently are enrolled due to coercion through the criminal justice system.

With Ramsey pricing and price discrimination for private payers, the total revenue for treatment clinics could be expanded. Currently, there is some price discrimination and price variation across payers. However, taking a Ramsey pricing approach might help to optimize the system and to provide more treatment through enhanced revenue while still attracting clients into treatment. Rather than offering price discrimination on the basis of insurance status, a Ramsey-priced regime would discriminate on the basis of the addict’s inherent demand for treatment. The administrative challenges of actually imposing a system of Ramsey prices that charged each client in perfect proportion to their willingness to pay would be formidable. However, instead of individual level price discrimination, market segmentation might be more feasible perhaps by clinic or by program within a clinic. Our findings suggest that product attributes could be powerful determinants of the decision to purchase and that they may matter more than personal characteristics. Thus, program characteristics may be the best, and certainly easiest, vehicle on which to base price discrimination. Some clinics could offer a higher level of services to attract those more willing to pay. Segmentation of the market for drug rehabilitation is currently practiced to some extent on the basis of location, services, clientele, and hours of operation within urban areas. Clinics or programs offering higher service quality or specific services, such as case management, would attract those willing to pay higher fees. Issues of equity in provision of higher services for some might surface, but this concern would by partially offset by the potential to increase the total amount of funds for treatment.

With more revenue being drawn from users it might be possible to increase the number of individuals who seek treatment. This could be done by using the revenue for social marketing (e.g. public service announcements) if some of the revenues accrued to government payers. Another approach would be to identify a subset of clients who would only respond to negative prices. Negative prices essentially pay addicts to use treatment services. The expense of this approach could be financed in part by the higher revenue from Ramsey pricing for paying patients. “Contingency management” approaches have been found to be effective in keeping clients in treatment and increasing the length of
time abstinent (Petry et al., 2005) These systems are often designed with escalating payments systems which increase the price of using of drugs over time and with ‘booster payments’ which helps to lengthen time in treatment.

In sum, this study shows that drug addicts’ demand for methadone treatment depends on price, service amenities and perceived treatment outcomes. We estimate the price elasticity of demand for out patient methadone treatment to be $-0.39$ (95% CI: $-0.47$ to $-0.31$). We believe that this is the first estimate of the price elasticity of demand. Estimates of addicts’ demand for drug treatment have many policy applications, one of which is the development of an optimal subsidy system. The appropriate deployment of cost-sharing mechanisms can increase the revenue for programs and potentially leverage public funds to further expand treatment availability and conduct outreach. Informed and thoughtful development of cost-sharing mechanisms for drug treatment can expand service capacity and reduce the negative externalities associated with drug use. Use of the full spectrum of prices, including negative, may further reduce the social cost of drug abuse through treatment.

Acknowledgements

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Appendix A

The first order condition for Eq. (1) is:

$$N^A \left( \frac{dU^A}{dm} \frac{dm}{dp} + \frac{dU^A}{dy} \left( m - (p - s) \frac{dm}{dp} \right) \right) + N^T \left( \frac{dU^T}{dy} \left( \theta m - \theta s \frac{dm}{dp} \right) \right) = 0 \quad (A1)$$

$$N^A \left( \frac{dU^A}{dy} \left( -m + (p - s) \frac{dm}{dp} \right) \right) + N^T \left( \frac{dU^T}{dy} \left( \theta m + \theta s \frac{dm}{dp} \right) \right) \quad (A2)$$

$$N^A \left( \frac{dU^A}{dy} \left( \theta m + \theta s \frac{dm}{dp} \right) \right) + \theta N^T \left( \frac{dU^T}{dy} \left( 1 + s \frac{dm}{m \ dp} \right) \right) \quad (A3)$$

but

$$\theta N^T = N^A$$

so

$$\left( \frac{dU^A}{dm} \frac{dm}{dy} \right) = \left( \frac{dU^A}{dy} \left( -1 + \frac{(p - s) \ dm}{m \ dp} \right) \right) + \left( \frac{dU^T}{dy} \left( 1 + \frac{s \ dm}{m \ dp} \right) \right) \quad (A4)$$

noting that

$$\varepsilon_p \equiv \frac{dm}{dp}$$

$$\frac{dU^A}{dm} \varepsilon_p = \frac{dU^A}{dy} \left( \left( \frac{p - s}{p} \right) \varepsilon_p - 1 \right) + \frac{dU^T}{dy} \left( \left( \frac{s}{p} \right) \varepsilon_p + 1 \right) \quad (A5)$$

Define

$$\varphi = \left( \frac{dU^T / dy}{dU^A / dy} \right)$$

$$\text{MRS}^A \left( \frac{\varepsilon_p}{p} \right) = \left( \left( \frac{p - s}{p} \right) \varepsilon_p - 1 \right) + \varphi \left( \left( \frac{s}{p} \right) \varepsilon_p + 1 \right) \quad (A6)$$
\[ \text{MRSA} \epsilon_p = p e_p - s e_p - p + \varphi s e_p + \varphi p \]  
(A7)

\[ \text{MRSA} \epsilon_p + p(1 - \varphi - \epsilon_p) = s e_p(\varphi - 1) \]  
(A8)

\[
\begin{align*}
    s &= \frac{\text{MRSA} \epsilon_p + p(1 - \varphi - \epsilon_p)}{\epsilon_p(\varphi - 1)} \\
    \text{A9}
\end{align*}
\]

\[
\begin{align*}
    s &= \frac{\text{MRSA}}{(\varphi - 1)} + \frac{p(1 - \varphi - \epsilon_p)}{(\varphi - 1)\epsilon_p} \\
    \text{A10}
\end{align*}
\]

Applying quotient rule \( d(u/v) = (v du - u dv)/v^2 \)

\[
\begin{align*}
    v &= (\varphi - 1)\epsilon_p \\
    dv &= (\varphi - 1) \\
    u &= p(1 - \varphi - \epsilon_p) \\
    du &= -p \\
    dx &= \left[ (-pe_p) - p(1 - \varphi - \epsilon_p) \right] \\
    d\epsilon &= \frac{(\varphi - 1)\epsilon_p^2}{(\varphi - 1)\epsilon_p^2} \\
    \text{A11}
\end{align*}
\]

\[
\begin{align*}
    dx &= \frac{p}{\epsilon_p^2} \\
    \text{A12}
\end{align*}
\]

\[
\text{Appendix B}
\]

Derivation of condition for zero subsidy.

\[
\begin{align*}
    -\psi e_p > \frac{p(1 - \varphi - \epsilon_p)}{(\varphi - 1)\epsilon_p} \quad \text{(B1)}
\end{align*}
\]

If \( \varphi > 1 \)

\[
\begin{align*}
    -\psi e_p > p(1 - \varphi - \epsilon_p) \quad \text{(B2)}
    \\
    \psi e_p < p(1 - \varphi - \epsilon_p) \quad \text{(B3)}
    \\
    \psi > \frac{p(1 - \varphi - \epsilon_p)}{\epsilon_p} \quad \text{(B4)}
\end{align*}
\]

\[
\text{References}
\]


