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## Variation in use of Buprenorphine and Methadone Treatment by Racial, Ethnic and Income Characteristics of Residential Social Areas in New York City

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### Abstract

National data indicate that patients treated with buprenorphine for opiate use disorders are more likely to be White, highly educated, and to have greater incomes than those receiving methadone, but patterns of buprenorphine dissemination across demographic areas have not been documented in major metropolitan areas where poverty, minority populations and injection heroin use are concentrated. Rates of buprenorphine and methadone treatment are compared among areas of New York City defined by their income and ethnic/racial composition.

Residential social areas (hereinafter called social areas) were defined as aggregations of ZIP codes with similar race/ethnicity and income characteristics, and were formed based on clustering techniques. Treatment rates were obtained for each New York City ZIP code: buprenorphine treatment rates were based on the annual number of buprenorphine prescriptions written, and the methadone treatment rate on the number of methadone clinic visits for persons in each ZIP code. Treatment rates were correlated univariately with ethnicity and income characteristics of ZIP codes. Social area treatment rates were compared using individual ANOVA models for each rate.

Buprenorphine and methadone treatment rates were significantly correlated with the ethnicity and income characteristics of ZIP codes, and treatment rates differed significantly across the social areas. Buprenorphine treatment rates were highest in the social area with the highest income and lowest percentage of Black and Hispanic residents. Conversely, the methadone treatment rate was highest in the social area with the highest percentage of low income and Hispanic residents.

The uneven dissemination of Opioid maintenance treatment in New York City may be reflective of the limited public health impact of buprenorphine in ethnic minority and low income areas. Specific policy and educational interventions to providers are needed to promote the use of buprenorphine for opiate use disorders in diverse populations.

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## INTRODUCTION

Opiate agonist therapies for opiate dependence lower HIV incidence and arrest rates among injection drug users<sup>1,2,3</sup>, so enhancing access to these treatments is a major public health priority. Buprenorphine, a partial opiate receptor agonist approved by the U.S. FDA in 2002 for treatment of opiate dependence, offers important advantages over methadone maintenance. Buprenorphine is less lethal in overdose than methadone<sup>4</sup>. The most commonly prescribed formulation of buprenorphine, in which it is combined with the opiate antagonist naloxone, produces opiate withdrawal when injected, limiting its abuse potential<sup>5</sup>. Because of these lower risks, buprenorphine can be prescribed by office-based generalist physicians, potentially increasing treatment access and reducing stigma in comparison to methadone<sup>6</sup>, which is restricted to federally regulated methadone clinics.

Few physicians offer buprenorphine treatment despite its advantages<sup>7</sup>. While policies such as state Medicaid coverage of buprenorphine are related to physician adoption<sup>8,9</sup>, and while Federal and regional initiatives have sought to increase the number of prescribers, the number remains inadequate to care for opiate dependent people<sup>10</sup> particularly among low income patients. For example, based on a comparison of the Federal register of buprenorphine certified prescribers published by the U.S. Substance Abuse and Mental Health Services Administration with the New York City Medicaid provider network provided by the New York State Medicaid office as of 2012 only 94 of the 899 buprenorphine certified prescribers in the five boroughs of New York City (10.4%) accept Medicaid payments. In contrast, Medicaid pays for a large percentage of methadone patients in New York City<sup>11</sup>. The way that opiate dependent people find their way to treatment also differs by medication: buprenorphine providers are listed on an internet site and rely on patients' initiative and access to web-based resources, while methadone clinics get referrals from a wide range of agencies serving low income people, including public health clinics, social welfare offices and the criminal justice system<sup>12,13,14</sup>.

As might be predicted based on these differences in provider characteristics and treatment referral pathways, national data regarding the demographic characteristics of patients treated with buprenorphine indicate racial/ethnic and socioeconomic disparities in its use. National surveys of buprenorphine and methadone patients revealed that buprenorphine patients were more likely to be White (92% vs. 53% of methadone patients), employed (56% vs 29%), to have some college education (56% vs 19%), and that 75% were prescription opioid dependent rather than heroin dependent<sup>15</sup>.

Since buprenorphine has been disproportionately taken up by prescription opioid dependent patients in rural and suburban areas, these national data may not represent usage in major US cities. Little is known about racial, ethnic, and socio-economic patterns of buprenorphine treatment in major metropolitan areas, where impoverished ethnic minorities are residentially concentrated, and where the prevalence of heroin injection—and associated risks of infection and overdose—is high. The geographic concentration of poverty in American cities and its relationship to enduring racial/ethnic segregation are well documented phenomena<sup>16,17</sup>, leading to increased risk of interrelated health problems such as substance abuse, HIV, Hepatitis C and diabetes<sup>18</sup>. The disparate geographic dissemination of corresponding treatments therefore has important implications for public health.

This is particularly relevant to New York City, the largest city in the U.S., with residentially concentrated poverty, the greatest number of opioid abusers (of heroin or illicit opioids) with estimates ranging from 92,000 to 200,000, and only 21,600 of these initiating treatment in 2006<sup>19, 20</sup> (McNeely 2012). New York City also has the highest AIDS case rate of any U.S. city<sup>21,22</sup>. Additionally, the New York City Department of Health took initiative as early as

2003 to promote buprenorphine in its public hospitals as an HIV prevention measure, and New York State Medicaid covers buprenorphine prescriptions. Based on the size of its opiate dependent population, the impact of HIV on this population, and the early efforts of local officials to make buprenorphine accessible to low income patients, New York City offers an important study of buprenorphine uptake in urban, low income, ethnic minority areas.

Existing New York City data was used to examine the correlation of residential area-level measures of poverty, race, and ethnicity with rates of buprenorphine and methadone treatment use. The hypotheses tested is that methadone treatment rates are highest in the residential areas with the lowest incomes and highest percentages of black and Hispanic residents, while buprenorphine treatment rates are highest in the residential areas with the highest incomes and lowest percentages of black and Hispanic residents.

## METHOD

### Data

The study conducts secondary analyses of data collected for administrative purposes. Buprenorphine use is determined from data collected by the Federal Drug Enforcement Agency (DEA) on the number of outpatient buprenorphine prescriptions written in 2007 by postal ZIP code of the patient treated supplied to the authors by the New York State Bureau of Narcotics Enforcement. Although independent verification of the completeness of this data is not available, it is the most complete publicly available data set on buprenorphine prescriptions because retail pharmacies are Federally mandated to report the age, address and date of service for each buprenorphine prescription recipient to the DEA. Data on methadone use was obtained from the New York State Office of Alcoholism and Substance Abuse Services (OASAS) and are the number of all patients in a postal Zip code receiving methadone maintenance in methadone clinics in New York City in 2007. Estimates of missing data in this set are unavailable, but missing data are expected to be rare since all New York City methadone maintenance clinics are regulated by the New York State Office of Alcohol and Substance Abuse Services, and this data set is linked to reimbursements and used for budgeting purposes. To describe Zip codes, data on the proportions of the population who are living at less than two times below the poverty level, are Black non-Hispanic, and are Hispanic were obtained from 2000 US Census ZIP Code Tabulation area reports. Postal ZIP codes were matched into census ZIP code equivalents<sup>23</sup> to align them with census data. After exclusion of codes denoting water areas and non-residential areas, the sample consisted of 181 New York City census ZIP codes.

### Measures

Annual buprenorphine and methadone treatment rates were calculated for persons living in each ZIP code who had received treatment within the year. To be noted is that persons living in these zip codes, as is likely in NYC, could have traveled to other zip codes for their treatments. The annual total number of buprenorphine prescriptions (n=27,571) written to patients residing in each ZIP code was divided by 12 to approximate an unduplicated number of persons receiving prescriptions. To obtain a rate this number was divided by the number of persons residing in the ZIP code. The particular divisor used to unduplicate the count does not impact the analysis conducted. The methadone treatment rate was defined as the annual total number of people in a Zip code enrolled for any period of time in a methadone clinic (n=39,231), divided by the number of persons residing in the ZIP code. The buprenorphine and methadone treatment rates are in different units and hence not directly comparable. The study focus, however, is to separately assess the dissemination pattern of each medication, buprenorphine and methadone, among NYC residential areas.

To accomplish this, separate comparisons of each usage rate were made among aggregations of ZIP codes that were homogeneous with regard to income, race/ethnicity (social areas defined below).

### Social areas

Social areas are residential areas in which persons have similar living standards, ethnic backgrounds, and life-style<sup>24,25,26,27</sup>. For this study, ZIP codes were aggregated into social areas based on similarities in ZIP code racial/ethnic and income characteristics. Social area analysis is an established approach used in public health research to examine effects of residential characteristics on health and behavior, and to examine inequalities in health, when residential information is available for each subject but not other demographic information<sup>28,29,30,31</sup>.

Social areas were formed based on the three census variables that capture income and race/ethnicity using Ward's minimum-variance method in the SAS 9.2 Cluster procedure<sup>32</sup>. Starting with a pre-specified number of social areas, the procedure clusters Zip codes to minimize within-cluster variance over the three variables. A heuristic procedure was used to select the optimal number of clusters for ANOVA analyses of treatment rates. The results of clustering based on increasing numbers of social areas were reviewed. The final choice of the number of social areas was based on: (1) having enough clusters to minimize within-cluster variance and (2) having few enough clusters to have a sufficient number of Zip codes (the unit of analysis) to maximize power in the analysis of variance. Five social areas were selected.

Given that only publicly available aggregate (zip code level) data without personal identifiers were used in this study, the study was exempted from informed consent procedures by the Human Subject Review Boards of New York University and of Nathan Kline Institute for Psychiatric Research.

### Statistical analyses

Two levels of ecological analyses were conducted between treatment rates and neighborhood characteristics. First, ZIP code level treatment rates were related to income and racial/ethnic proportions of a ZIP code. Each rate was correlated univariately with race/ethnicity and income using Pearson's Product-Moment Correlation Coefficient. Significance is reported at the 1% level. While ANOVAs (or regression models) on zip codes might have been used for this analysis, multiple interaction terms would have been required in the models and their effects are notably difficult to interpret. Second, ANOVA models were used to compare treatment rates among social areas defined by the three census variables. A one-way analysis of variance was used to compare mean treatment rates of each (the average of rates across the ZIP codes in a social area) among the five social areas. Rates between areas were contrasted using the Tukey Studentized range test for pairwise comparisons corrected for multiplicity, which controls the family wise error rate at the 5% level. No variables were controlled for in the analysis of variance since the social area itself encapsulates race, ethnicity and income. No ZIP code level data were available on insurance status which could have impacted use; however in the U.S. income level and ethnicity are correlated with percent persons with insurance coverage<sup>33,34</sup>. All study analyses were conducted in SAS 9.2<sup>35</sup>.

## RESULTS

### Zip code level analyses

Across ZIP codes, the buprenorphine treatment rate was significantly ( $p < .01$ ) negatively correlated with percent of residents who are in poverty, Black non-Hispanic, and Hispanic while methadone rates were significantly ( $p < .01$ ) positively correlated with these variables (Table 1). Methadone rates were substantially ( $R > .55$ ) correlated with percent poverty and percent Hispanic. Buprenorphine rates were weakly correlated with all census variables ( $R < -.29$ ).

### Social area analyses

In order to better describe the social areas in terms of the census variables (percent of a characteristic), each characteristic was assigned a value of high (H), medium (M) or low (L) based on cutpoints obtained from a one dimensional clustering of the variable values across all zip codes into three tertiles. The tertile cut points for percent below two times poverty level are 33% and 51%; for percent Black non-Hispanic are 10% and 46% and for percent Hispanic are 22% and 47%. Fifty five ZIP codes were aggregated into social area 1 described as low poverty, low percent Black non-Hispanic, low percent Hispanic and denoted by L,L,L; an aggregation of 62 ZIP codes (social area 2) was characterized as moderate income, moderately non-Hispanic Black and moderately Hispanic (M,M,M); 27 ZIP codes (social area 3) as moderate income, highly Black non-Hispanic and low percent Hispanic (M,H,L); 15 ZIP codes (social area 4) as high poverty, moderate percent Black non-Hispanic, moderate percent Hispanic (H,M,M), and 22 ZIP codes (social area 5) as high poverty, moderate percent non-Hispanic Black, high percent Hispanic (H,M,H). The clusters were mainly but not necessarily geographically contiguous (Figure 1).

The social area L,L,L had the highest rate of buprenorphine users, and this rate significantly differed from rates of all other social areas ( $p < .05$  for all contrasts, Table 3).

Methadone treatment rates were the highest in social area 5 (H, M, H). Methadone treatment rates monotonically increased from social area 1 to 5 from a low of 21 persons per 10,000 in the highest income area to a high of 114 persons per 10,000 in the poorest area. The methadone rate for the high poverty area that was predominately Hispanic differed significantly from the rates of all other social areas. The high poverty area with moderately high proportions of both Blacks and Hispanics (H,M,M) had significantly higher rates of methadone use than the low poverty, predominately White area (L,L,L) and the moderate income area with moderate proportions of Blacks and Hispanics (M,M,M).

## DISCUSSION

Since demographic data on individual buprenorphine users is not routinely collected, information relevant to the population level distribution of buprenorphine treatment, relative to methadone treatment, has not been available at the regional level. This paper is unique in its comparison of buprenorphine with methadone usage patterns by the demographics of the neighborhoods of users, providing insight into dissemination patterns. It was found that buprenorphine treatment is unevenly distributed among New York City social areas and is concentrated in areas with the highest incomes and highest percentage of White residents. ZIP code level findings of a negative correlation of buprenorphine treatment rates, and a positive correlation of methadone treatment rates with poverty and Black or Hispanic ethnicity were confirmed by social area level multivariate analysis which shows that methadone has an inverse geographic distribution to that of buprenorphine.

The fifth social area (H,M,H), a high poverty, predominantly Hispanic social area that had an intermediate buprenorphine treatment rate and a high methadone treatment rate, is an exception. This area includes zip codes in the South Bronx served by Montefiore, a large hospital that offered buprenorphine to its primarily Medicaid insured and uninsured patients starting shortly after buprenorphine's FDA approval (New York City Department of Health Buprenorphine Task Force, personal communication, 2005). The influence of this hospital's early buprenorphine initiative is informative to dissemination analysis and may explain the intermediate buprenorphine treatment rate in this low income, ethnic minority social area. The social area of highest buprenorphine use included affluent ZIP codes of Staten Island, lower and midtown Manhattan, Queens bordering suburban Long Island, and one area of the North Bronx bordering suburban Westchester County. Impoverished neighborhoods of East New York and Harlem were in the social area with the lowest buprenorphine use. Stark geographic differences in buprenorphine and methadone treatment across New York City social areas are particularly concerning given the existence of local policies intended to support equitable dissemination of buprenorphine treatment. New York State was one of the first states to offer Medicaid coverage of buprenorphine-related office visits and buprenorphine prescriptions. The New York City Department of Health declared buprenorphine dissemination among low income patients a public health priority in 2003, one year after buprenorphine's FDA approval<sup>36</sup>; it launched an outreach campaign to public clinics which distributed promotional materials on buprenorphine, and offered buprenorphine certification training for public clinic physicians. Although the impact of these efforts on buprenorphine dissemination in public clinics has not been systematically evaluated, because few other major U.S. cities promote buprenorphine for publicly insured patients, and not all states' Medicaid programs cover buprenorphine prescriptions<sup>8</sup>, differences in New York City by social area may be smaller than those in other cities.

The low number of Medicaid-accepting buprenorphine prescribers relative to the potential demand for buprenorphine suggests a problem of access to buprenorphine prescribers among low income people. In contrast, buprenorphine usage in high income, largely White areas is most likely linked to providers who accept private insurance coverage. Furthermore the dissemination of buprenorphine as a viable treatment may be promoted by social networks of neighborhood residents who share treatment information; such networks have been shown to reinforce socio-economic and ethnic/racial differences in treatment<sup>37</sup>. Availability of providers in a ZIP code could potentially impact the dissemination of the two medications. However, the widespread availability of mass transit in New York City would strongly mitigate the effect of provider location on treatment provision. A shortage of public sector physicians who prescribe buprenorphine has been identified as a major barrier to dissemination among low income patients in a national study, and most buprenorphine prescribers are in private practice or are addiction specialists<sup>9</sup>. Interviews with buprenorphine prescribers reveal that private practice physicians charge substantial fees for buprenorphine treatment, while there are few professional or economic incentives for public sector physicians to offer buprenorphine treatment (Hansen H, unpublished data).

Other factors that may contribute to the low rates of buprenorphine treatment in low income, ethnic minority neighborhoods could be linked to professional and institutional treatment biases. These factors include: 1) Some addiction specialists express the view that buprenorphine is more clinically appropriate for employed, "stable" prescription opiate abusers than "unstable" heroin injectors<sup>38, 39</sup>. 2) The manufacturer's marketing of buprenorphine relies on internet-based publicity displaying employed, White prescription opiate abusing patients<sup>40</sup>, which may reflect that buprenorphine was approved for treatment of opiate dependence on the heels of a major U.S. epidemic of White, middle class prescription opiate abuse<sup>41</sup>. 3) A major mechanism for referral of patients to buprenorphine certified physicians is an online network sponsored by the federal Substance Abuse and

Mental Health Services Administration<sup>42</sup>; low income patients may not have access to online services.

Research and interventions to identify and redress the institutional and professional barriers to buprenorphine provision are needed. Effective dissemination of buprenorphine requires targeted efforts to promote buprenorphine prescribing among public sector physicians, particularly those in primary care who come into contact with large numbers of patients. Studies of buprenorphine dissemination through the NIDA Clinical Trials Network, and of the Physician Clinical Support System, indicate that linking buprenorphine experienced providers with inexperienced providers is effective in promoting buprenorphine prescription by widening circles of physicians<sup>43</sup>. Physicians are also more likely to prescribe buprenorphine when they believe their patient population has a need for treatment for opioid dependence, and when they perceive the treatment as relatively easy to administer<sup>44</sup>. These perceptions could be addressed in interventions that promote buprenorphine accessibility in public clinics.

Unlike buprenorphine treatment, methadone maintenance is targeted to low income patients. Methadone clinics have long been funded by city and state governments, methadone is considered one of New York City's major HIV prevention initiatives, and is routinely offered to opiate dependent recipients of public assistance<sup>13</sup>. There is, however, little clinical evidence of any advantage of methadone over buprenorphine for treatment of low-income patients. A clinical trial comparing buprenorphine with methadone treatment of low income opiate dependent arrestees initiating treatment prior to prison release, found no difference between patients in the two groups with regard to relapse, re-arrest or re-incarceration after release; in fact, treatment continuation rates were higher among those on buprenorphine<sup>45</sup>. Other studies suggest that patient preferences for, and outcomes on, buprenorphine are influenced by disease severity and comorbidity<sup>46,47</sup>; these factors should also be examined in future investigations of geographic and demographic patterns in buprenorphine dissemination.

This study has several limitations. The ethnic and socioeconomic backgrounds of buprenorphine and methadone users cannot be directly inferred from the characteristics of the area of their residence due to the risk of ecological fallacy. The ecological fallacy occurs when population level characteristic are ascribed to individuals in the area who do not have these characteristics, e.g. by assuming that all persons in a predominantly Black area are Black. Refraining from making inferences about how individual characteristics influence treatment, avoids the ecological fallacy, but does not allow for extrapolating from geographic distribution of treatment use to the characteristics of individual treatment users. Second, unmeasured neighborhood characteristics which influence methadone and buprenorphine treatment rates—such as disease prevalence, incidence, and severity—may be heterogeneously distributed across neighborhoods and may confound the relationships observed. Third, the estimate of the unduplicated count of buprenorphine users does not reflect the possible mixed frequency of prescription fillings. In any event, direct comparisons are not made between buprenorphine and methadone treatment rates within a social area or ZIP code due to differences in their units of measurement. Fourth, the U.S. Census demographic data used was collected seven years before the buprenorphine treatment data. Shifts in neighborhood population characteristics may have occurred in that time. Finally, New York City findings may not be generalizable to other U.S. cities.

### **Implications for Behavioral Health**

The unequal distribution of the new, lower risk treatment technology reported here is predicted by social epidemiological theory: new technologies disproportionately benefit high income consumers with the means to access them. Therefore treatment innovations can

widen disparities unless concerted public efforts counteract social processes underlying disparities<sup>48,49</sup>. In addition, analyses that take into consideration the interaction of geographic patterns of health and health care with local cultural and institutional practices are crucial for developing appropriate and context-dependent interventions<sup>50</sup>. For example, access to a full range of convenient, safe treatments for opiate dependence in low income and ethnic minority neighborhoods is a particular public health imperative because the most severe consequences of untreated opiate dependence—HIV infection, overdose and incarceration—are concentrated there. Physicians serving low income patients already face the challenge of growing caseloads and declining reimbursements due to reduced governmental support for the public health sector. In New York State, providers saw \$204.9 million in cuts Medicaid for mental health services between 2009-2012<sup>51</sup>, and \$46 million in cuts to the Office of Alcoholism and Substance Abuse in 2011 alone<sup>52</sup>. Specific physician incentives to increase the number of buprenorphine prescribers in the public sector - those who serve the largest number of patients at risk for opiate related infection, overdose and incarceration - should be considered as a preventive health investment. Follow up studies of the physician-level, institutional and policy factors related to the adoption of buprenorphine should provide information to refine treatment dissemination interventions and achieve the public health gains heralded with the introduction of buprenorphine treatment.

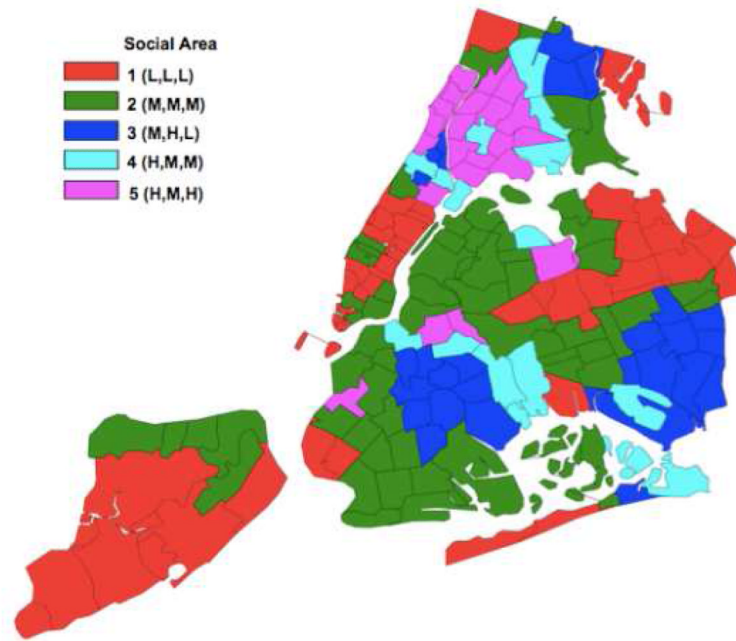
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**Figure 1. Map of New York City Social Areas**

Social area notations in parentheses indicate proportions of area residents who are impoverished, Black non-Hispanic, and Hispanic, respectively. L,M, and H denote low, medium, and high proportions, respectively. See text for definitions of social areas and treatment rates.

**Table 1**

Corellation coefficients (R and p values) for associations between treatment rates and proportion of residents who are impoverished, Black non-Hispanic, and Hispanic in New York City ZIP codes

<b>Proportion of Zip Code Area with Demographic Characteristic</b>			
<b>Treatment</b>	<b>% Below 2X Poverty</b>	<b>Black, non-Hispanic</b>	<b>Hispanic</b>
Methadone	0.57 (<.0001)	0.24 (.001)	0.55 (<.0001)
Buprenorphine	-0.26 (.0005)	-0.29 (<.001)	-0.18 (.01)

Correlation coefficients are univariate, unadjusted estimates. See text for definition of methadone and buprenorphine treatment rates.

**Table 2**

## Demographic Characteristics of social areas

Mean % if characteristic across zip codes in social area (SD)					
Social Area	Social Area Label	# (%) of ZIP Codes in Area	% Below 2X Poverty Level	Black, non-Hispanic	Hispanic
1	(L,L,L)	55 (30.4)	17.2 (5.7)	3.1 (2.9)	9.0 (4.2)
2	(M,M,M)	62 (34.2)	37.9 (12.1)	11.5 (10.5)	23.6 (11.3)
3	(M,H,L)	27 (14.9)	39.2 (14.3)	75.6 (12.6)	11.6 (5.8)
4	(H,M,M)	15 (8.3)	57.1 (12.3)	43.8 (10.8)	37.1 (11.4)
5	(H,M,H)	22 (12.2)	61.9 (6.4)	21.9 (10.9)	66.3 (7.4)

L, M, and H denote low, medium, or high tertiles variables within social area.

SD denotes standard deviation.

See text for definition of social areas.

**Table 3**

Mean annual number of buprenorphine and methadone treatments per 10,000 residents (treatment rates), by social area

Social Area	# of buprenorphine prescriptions filled (SE)	# of persons receiving methadone (SE)
1 (L,L,L)	5.1 (4.9) <sup>1</sup>	20.6 (20.4) <sup>3</sup>
2 (M,M,M)	2.9 (2.4) <sup>2</sup>	37.1 (34.7) <sup>3</sup>
3 (M,H,L)	1.2 (1.4) <sup>2</sup>	45.4 (30.2) <sup>4</sup>
4 (H,M,M)	1.3 (1.1) <sup>2</sup>	75.6 (69.6) <sup>4,5</sup>
5 (H,M,H)	2.8 (3.4) <sup>2</sup>	114.2 (71.1) <sup>6</sup>

Social area notations in parentheses indicate relative proportions of area residents who are <2X poverty level, Black non-Hispanic, and Hispanic, respectively. L, M, and H denote low, medium, and high tertiles of variables within social areas, respectively. SE denotes standard error. See text for definitions of social areas and treatment rates.

<sup>1</sup>Significantly greater than the buprenorphine treatment rates for social areas 2, 3, 4 and 5.

<sup>2</sup>Significantly less than the buprenorphine treatment rate for social area 1.

<sup>3</sup>Significantly less than the methadone treatment rates for social areas 4 and 5.

<sup>4</sup>Significantly less than the methadone treatment rates for social area 5.

<sup>5</sup>Significantly greater than the the methadone treatment rate for area 1.

<sup>6</sup>Significantly greater than the methadone treatment rates for social areas 1, 2,3,4.

Social area treatment rates contrasted using the Tukey studentized range test for pairwise comparisons corrected for multiplicity, controlling family wise error rate at the  $p < .05$  level.