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Examining the Impact of California's Medical Marijuana Program on Public Health

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CLAREMONT McKENNA COLLEGE

**EXAMINING THE IMPACT OF CALIFORNIA'S MEDICAL MARIJUANA PROGRAM ON
PUBLIC HEALTH**

SUBMITTED TO

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AND

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BY

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FOR

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ABSTRACT

The debate surrounding marijuana legalization has increased its popularity in recent years, as the state of California seriously considers the complete legalization of the substance for those ages 21 and over. This would make California the first government in recorded history to regulate the cultivation and sale of marijuana on a commercial level. Advocates back the economic positives concerning high tax revenues, but those opposed argue that the dangers associated with public health greatly outweigh any monetary gain. The present study attempts to reveal the possible public health concerns, even potential benefits, caused by marijuana use and its distribution. Specifically, measures of California's Medical Marijuana Program will be assessed on the total number of drug treatment admissions in each county, taking into account treatment type and which type of drug is primarily responsible for said admissions. Findings reveal influences by both gateway and substitution effects, creating both positive and negative correlations throughout the field of public health. The influences of intangible variables, like that of the black market, make the results difficult to generalize. However, significant correlations can be found among specific health factors, like Heroin use, Crack/Cocaine use, and Residential Treatment.

INTRODUCTION

The state of California has found itself at the center of the world's continuing debate over progressive marijuana use and cultivation legislation. Though countries like the Netherlands and Australia have successfully decriminalized the use of marijuana on various levels, advocates for legislative reform in California are calling for complete legalization for those ages 21 years old and over, including the personal use, possession, and cultivation of the substance. California would also become the first government in history to regulate the cultivation and sale of marijuana on a commercial level, applying taxes and associated fees on the goods. Reform support from habitual users of the drug may seem obvious, as the legal risks associated with the use will be diminished. However, it is the economic reasons that have influenced the general population to seriously consider joining the advocacy. The cash-strapped state of California has been forced to dramatically cut public services, including health care, education, and public safety, and has been looking for sources of revenue to support said departments (Pacula, 2010). A recent report from the California State Board of Equalization estimated that the taxation of legalized marijuana, with an expected tax of \$50 per ounce, would generate \$1.4 billion for the state each year (Kilmer et al. 2010). However, not everyone is convinced that the net effect of the legalization of marijuana will be positive, for there exist various public health concerns associated with the inevitable rise in consumption rates. The increase of treatment episodes, hospitalizations, and the financial costs related to such harmful measures may be just enough to keep legalization of marijuana from becoming a reality.

In 1996, California voters said yes to the Compassionate Use Act (California State Proposition 215) which allowed medical marijuana to be dispensed to patients with a doctor's recommendation. It was not until 2003 that Senate Bill 420 was written into law, creating the

state's Medical Marijuana Program (MMP). This clarified the application of the Companionate Use Act and paved the way for counties to participate in medical marijuana identification card programs, which distribute and regulate cards protected by the state (Lipton, 2010). However, MMP-authorized Medical Marijuana Identification Cards are becoming increasingly easy for the average citizen to obtain. Simple complaints of back pain or insomnia can quickly result in the attainment of a card, which means those with ulterior motives of reselling marijuana and marijuana products can gain access to quality strands of the substance. One must assume, then, that the number of cards distributed has an amplified effect on the amount of marijuana circulating in the area. Effectively, marijuana still finds its way to the hands of recreational users despite the medically backed intentions of the MMP.

Marijuana continues to be controlled solely as a form of medication in California due to the unclear effects associated with habitual recreational use. Even though little evidence exists on the direct effects of the drug when used independently, the illegalization of the substance has still left a stigma on the American society. Evidence concerning the harmful effects produced when the drug is combined with other substances like alcohol, however, points to an increased overall impairment of sensory and motor skills (Blows et al. 2005). In turn, marijuana is held responsible for many of the hospitalizations due to drugged driving accidents and other personal injury. People also see marijuana as a gateway to other, more harmful drugs such as Crack/Cocaine, Heroin, and Methamphetamines. If a more generalized form of marijuana legalization was instilled, this theory would predict higher abuse of said illicit drugs (Morrall et al. 2002).

Treatment records offer a quantifiable insight into the rates of drug abuse, as each admission is defined by what type of treatment is applied and what substance was the primary source of the problem. If marijuana has indeed had an effect on public health, indications may

be revealed through the correlation of marijuana consumption and drug treatment admissions. In this paper, I will attempt to identify the overall effects that marijuana has had on public health, which could offer new information to the debate surrounding its complete legalization. The relationships between MMP-authorized Medical Marijuana ID Cards and various drug related treatment admissions will be explored. I will also analyze the effects of county-level activation of the MMP by indentifying whether the launch of the program alone had any influence on treatment admissions.

The results revealed possible influences by both gateway and substitution effects. Crack/Cocaine admissions showed positive correlations with the amount of cards distributed (gateway), while the same relationship with Heroin admissions was negative when year and county fixed effects were included (substitution). Of the various treatment types, Residential Treatment admissions had the only significant relationship with cards, which was also positive. The average reliability of the findings, reflected by the R-squared values, was low, showing that additional variables must be accounted for in order to produce more convincing results.

LITERATURE REVIEW

The rates of marijuana use across the United States have remained relatively consistent for the last 20 years, with only minor exceptions. For the American population ages 17 and over, frequency of use has indeed remained steady (SAMHSA, 2009). When focus is narrowed to just adolescents and young adults ages 12 to 17, however, the rates show considerable fluctuation. Though there is no consistent trend that can be identified over the span of the two decades that explains these fluctuations, data from more recent years reveal that the prevalence of past-month marijuana users in said age group has been decreasing since 2002, from 8.2% to 6.7%. Notably, the percentage of adolescents and young adults who perceived great risk from smoking marijuana once a month has increased since 2002, from 32.4% to 34.5%. This would imply that there exists some kind of contemporary youth movement away from marijuana consumption, possibly due to reformed education or social norms; though the stigma has not proven to last into adulthood.

Kilmer et al. (2010) found that when California is compared to other states across the country, rates of marijuana use were fairly similar to the national average. As of 2007, 7% of Californians ages 12 and older have reported using marijuana in the last month, compared to the 6% that represents that national average. The difference between the percentages of adolescents and young adults who have used marijuana in the past month is even smaller than that of the older age group. Consumption rates in the different regions within the state of California show great amounts of variability. Rates in Northern California are the highest, which is understandable considering that this is the center of the state's marijuana production. The Los Angeles County, Santa Clara County, and the central interior regions of the state hold the lowest rates of marijuana use.

Despite pushes in legislative reform like that of Proposition 215 in 1996, statistical trends in California do not indicate any increased prevalence in marijuana use in the recent years (SAMHSA, 2009). One must assume that future use will stay consistent with the historic averages, as it has for decades. However, the current issue surrounding the complete legalization of marijuana for those 21 years of age and older opens a door to the new possible influences that could change the marijuana consumption rates. In order to predict the effects of legalizing marijuana on future consumption, Kilmer et al. (2010) used an economic model that takes into account current consumption, current and future prices, the elasticity of the good, future taxes, and the influence of non-price effects. No modern nation has legalized the commercial production of marijuana, which leaves no relevant data available to offer insight into the estimates of factors like price elasticity and production costs after legalization. Average retail prices will be difficult to predict due to their dependence on imposed and collected tax amounts, which are also undetermined. Non-price effects, therefore, are necessary in order for one to determine the overall movement of consumption; it is the missing specifics of the future consumption model that will determine by just *how much* consumption will change.

In using the economic model to predict future consumption, one must realize the many factors that contribute to the non-price effects. MacCoun (1993) identified 6 different mechanisms by which a change in marijuana legislation might influence consumption: *availability, symbolic threshold, fear of formal sanctions, "forbidden fruit", stigmatization/labeling, and bolstering of informal norms*. The *availability* mechanism refers to the supply of the drug and how easily the consumer can access the drug in its different forms, like traditional buds sold by the gram, edibles, clones (infant marijuana plants ready for cultivation) and seeds. The *symbolic threshold* mechanism refers to how marijuana use is connected with certain stereotypical images and characteristics that have risen because of

controversies surrounding the substance throughout history. For example, someone who uses marijuana might be looked down upon by their peers because it has been deemed as an illegal and dangerous activity by higher authorities and their legislation. Most people are inherently law-abiding, so negative images will be matched with anyone who uses the substance. The *fear of formal sanctions* mechanism refers to the law enforcement's ability to punish those who use marijuana and the influence that has on use. The fear of arrest, heavy fines, and jail time all act as strong deterrents against frequent use. The "*forbidden fruit*" mechanism refers to the potential attraction that is associated with doing something that is deemed illegal or taboo. The *stigmatization/labeling* mechanism is like the "*forbidden fruit*" mechanism because of its rebellious nature. It refers to the negative emotions connected with marijuana related law enforcement activities, for some believe that they are imposing their will on a subject that is very individualistic and of no business to anyone but the user. The *bolstering of informal norms* mechanism refers to how the informal society will react to a change in legislation. This effect can be seen through peer interactions and popular trends that are related to the average citizen.

MacCoun and Reuter (2001) were able to qualitatively determine the correlation that each mechanism has on consumption. If marijuana was in fact legalized, consumption would theoretically increase due to greater availability, less fear of formal sanctions, and a weaker symbolic threshold effect. Influences caused by the elimination of the "*forbidden fruit*" effect and decreased rebellion against authority should lower consumption by some effect. It is unclear what would happen to the position of informal norms, so this additional factor could either increase or decrease consumption depending on the reaction of the general public and the media after reform. It is estimated that marijuana use and dependence will increase with legalization, but we do not know enough about each mechanism to be able to determine the

relative importance that each one carries. This makes it impossible to identify the quantitative net impact with any real confidence. One thing is certain, if legalization leads to increased use of marijuana, this will inevitably lead to an increased probability of the drug's abuse. We must consider, then, how the number of drug treatment admissions will be affected by legislative reform.

Though other drugs like Crack/Cocaine, Heroin, and Methamphetamines are far more dangerous when heavily abused, Marijuana is still the primary drug of abuse in one-fifth of California treatment admissions (Pacula, 2010). This rate has grown significantly over the past fifteen years, as Marijuana represented only 6% of total admissions in 1995 and now accounts for more than the 19% of total admissions reported in 2009. Patterns in the Netherlands, Australia, and other parts of Europe support this trend, as marijuana use becomes more prevalent and accepted in their societies. From 2005 to 2008, 89% of the marijuana admissions in California were handled in outpatient settings, while 8.5% of the remaining admissions resulted in long-term residential treatment. Up to half of marijuana treatment admissions in California involve youth between the ages of 12 and 17 years old, while those between the ages of 18 and 20 years old represent approximately 11% of admissions.

Pacula (2010) discusses the perennial debate surrounding marijuana admissions and whether or not they are correctly defined. There are concerns with whether marijuana admissions are genuine in the sense that they are medically necessary or whether they are merely a product of the criminal justice system. Courts are increasing treatment referrals, especially among young adults, as a form of prison diversion (SACPA, 2005). Over the past decade, the percentage of marijuana treatment episodes involving criminal justice referrals remained around 50%, peaking at 60% in 2002. The legalization of marijuana would make such

treatment referrals disappear from the courts, at least for those above the age of 21 years old. Until then, the raw number of marijuana admissions must be considered with a careful eye, for criminal justice referrals dominate this treatment type more than any other drug.

Morrall et al. (2002) explores the theory surrounding the possible “gateway effect” associated with marijuana use and how it would affect various drug treatments. The marijuana gateway theory claims that the use of marijuana by those who have not yet experimented with other forms of drugs will have an increased probability of initiating the use of harder drugs, such as Crack/Cocaine, Heroin, and/or Methamphetamines. The report examined whether these associations could instead be explained by drug use propensity, which would influence the probability of using any type of drug. Marijuana is often the first illicit drug used by people, so it is repeatedly pointed to as the sole reason that a person would move onto to anything harder. However, one must consider the fact that many of those who “move on” to harder drugs would have eventually used them even without trying marijuana first, simply as a result of their high propensities to experiment with mind altering substances. Their findings revealed that the probability of initiating the use of hard drugs increased if marijuana was tried first, which supports the gateway effect. The study admitted that drug use propensity is almost impossible to measure by the applied model; one would need to know what would have happened if a hard drug user who used marijuana first never had tried marijuana in the first place.

Until we can find a legitimate measure of drug use propensity, we must accept the gateway theory on some level. In turn, any form of marijuana legalization, which is projected to increase marijuana consumption (Kilmer et al. 2010, Pacula 2010, MacCoun 2010), should have an increased effect on harder drug use and abuse. As hard drug abuse increases, so will the

number of treatment admissions for said drugs. This reveals just how many levels marijuana legalization can affect, from use, to abuse, to overall treatment for all types of drugs.

Marijuana is often considered harmful not only because of its connection to harder drugs, but also because of its magnification effect on impairment when combined with other substances such as alcohol (Pacula, 2010). The literature concerning the circumstances where marijuana use alone resulted in one's hospital admittance is very limited. This is mostly because the majority of people who are admitted for complications involving marijuana use have also used other substances prior to admittance, so the direct effect of the marijuana use cannot be discerned. The chemical properties and current administration methods for marijuana make it unlikely to cause severe health problems when used in relative moderation. It is possible that legalization will lead to more marijuana being consumed in different methods, like brownies and drinks, which might make it more difficult for the user to control his or her dosage.

Drugged driving statistics help reveal just how dangerous marijuana can be when combined with another substance. Though there has been significant experimental literature suggesting diminished response rates and performance under very strictly controlled situations, epidemiological studies reveal less conclusive results (Ramaekers et al. 2004). When marijuana is paired with alcohol, however, evidence is clear that the combined effect of the substances impairs one's ability to drive significantly more than alcohol alone. Those who want to use marijuana responsibly must be mindful of the dangers that arise from all different situational factors, whether it is the amount one uses at one time, the environment in which one uses the substance, or the other kinds of substances being combined with the drug.

Reuter (2010) understands that though we may have a general understanding of the effects associated with marijuana legalization and consumption, there is no example in history

that can reveal the exact effects that will sprout from the level of reform being considered by California legislation today. Countries like the Netherlands and Australia have reduced the legal risks associated with marijuana use and cultivation, however, there has never been a country that has not only decriminalized the substance for a certain age group, but has also authorized the commercial production and regulation of the distribution of marijuana and marijuana products. General implications of price and availability can be found by available precedents, but the magnitude of the non-price effects of this kind of legalization has never been seen or studied before. The uncertainties surrounding drug use and abuse, when all previous restrictions connected with the drug have been removed, make this debate impossible to quantify. The closest example of an end to a prohibition of this size was that of the alcohol prohibition in the United States in 1933, which legalized the production, distribution, and consumption of previously banned alcoholic beverages. However, alcohol and marijuana are hardly substitutable, and marijuana was never before legalized to the effect that alcohol was before the beginning of the Prohibition in 1920. Therefore, we must look at marijuana-related legalizations of smaller magnitudes, like that of the quasi-legal status implemented by California's Medical Marijuana Program, and use associated trends to make conclusions about the greater issue. Real implications may vary when generalized, but the overall correlations should reflect actual trends.

DATA

The data chosen in the present study were used to analyze the effects of the authorization and distribution of medical marijuana cards on various public health elements. Data were collected from 2001 to 2008 on 30 California counties (240 sets of observations) with a mean population of 880,645. The largest county was Los Angeles, with a peak population of 10,301,658 in 2008, and the smallest county was Del Norte, with a low population of 27,650 in 2001. The standard deviation for population was a high 1,835,295, allowing for a large range of county size classifications. Population data was supplied by the RAND Corporation Population and Demographic Statistics database, which cites the California Department of Finance as their source.

Two independent variables were used to measure the effects of California's Medical Marijuana Program (MMP): a continuous variable on the annual number of MMP-approved Medical Marijuana Identification Cards distributed by county and a binary variable on whether a county authorized the distribution of said medical marijuana cards for that year. Medical Marijuana ID Cards are valid for one year, so distribution numbers reflect the actual circulation of activated cards for each year (Table 1). The number of cards distributed should act as a solid representation of the amount of medical marijuana being used in the given area, as we do not have a tangible measure of marijuana use via the black market. The MMP, a program directed by the California Department of Public Health, was established to provide a voluntary medical marijuana identification card issuance and registry program for qualified patients and their caregivers. However, all counties did not begin distributing Medical Marijuana Identification Cards immediately after the Medical Marijuana Program Act, Senate Bill 420, was passed in

2003 (effective in 2004). Card data totals and whether or not a county even distributed cards for that year were collected by the MMP web-based and county-specific registry system.

Amador, Del Norte, and Mendocino were the only counties to distribute MMP-authorized Medical Marijuana ID Cards beginning in 2004. Orange and Ventura, on the other hand, did not begin distributing cards until 2007 and 2008 respectively. In 2004, only 10% of the sample counties distributed MMP-authorized cards, producing a total of 85 cards ($\mu=2.83$ for all counties). In 2005, 57% of the sample counties distributed MMP-authorized cards, producing a total of 4,123 cards ($\mu=137.33$ for all counties). In 2006, 77% of the sample counties distributed MMP-authorized cards, producing a total of 10,206 cards ($\mu=340.20$ for all counties). In 2007, 97% of the sample counties distributed MMP-authorized cards, producing a total of 8,302 cards ($\mu=275.73$ for all counties). In 2008, all of the sample counties distributed MMP-authorized cards, producing a total of 8,887 cards ($\mu=296.23$ for all counties).

Seven dependent variables were explored to measure effects on various public health elements: Narcotic Treatment Program (NTP) admissions, Outpatient Treatment admissions, Residential Treatment admissions, and treatment admissions according to primary drug use problems, including Marijuana/Hashish, Crack/Cocaine, Heroin, and Methamphetamines. The data were supplied by the RAND Corporation Community Statistics database, which retrieved the data from the California Department of Alcohol and Data Programs. They defined admissions for NTPs as non-hospital methadone maintenance programs and non-hospital other prescribed medication maintenance programs. NTP data from 2006 to 2008 were significantly lower and less available on average due to the increases in Substance Abuse and Crime Prevention Act (SACPA)/other criminal justice clients. The proportion of SACPA/criminal justice clients has steadily increased from about 20% of the total treatment population in 2000 to roughly 50% in 2007. This treatment not only rests under a different system and classification as

NTPs, but it now includes many types of clients that were previously defined as NTP patients before 2006. This could impair analysis, as there is no way to calculate the exact amount of recent SACPA/criminal justice clients that would have previously have been defined under NTPs. Outpatient Treatment admissions include Outpatient Day Programs (treatment centers) and Outpatient Drug Free Programs (sponsored housing and sober living). Residential Treatment admissions include in-hospital drug treatment for both <31 days and >30 days categories.

All admissions to either hospital or non-hospital treatment programs define which drug was the primary cause of the patient's problem. Analysis on Marijuana/Hashish drug problems is especially relevant in order to observe any direct effect by the independent variables. On average, Marijuana/Hashish (236 observations) accounted for 125.75 ($\sigma=79.93$) treatment admissions a year per 100,000 citizens. Aside from the category of alcohol, Crack/Cocaine, Heroin, and Methamphetamines were the top substances contributing to drug/substance related admissions. Crack/Cocaine (205 observations) accounts for an annual average of 63.58 ($\sigma=74.84$) treatment admissions per 100,000 citizens. Heroin (205 observations) accounts for an annual average of 119.15 ($\sigma=132.42$) treatment admissions per 100,000 citizens. Methamphetamines (239 observations) account for an annual average of 275.05 ($\sigma =161.83$) treatment admissions per 100,000 citizens.

DATA ANALYSIS

To examine the general effects that the California MMP has had on various drug-related public health elements, I initially graphed scatter plots of the number of MMP-authorized Medical Marijuana ID Cards on each drug treatment type and primary drug abused. A trend line was added to each graph to reveal the general correlations. Data was only considered if it reflected a time period in which its pertaining county had accepted and implemented the county-level MMP; all zeros were removed from the card totals and those data points were no longer considered. This controls for many of the admission fluctuations before county-level MMP execution. Therefore, results will offer more focused marginal effects, making the direct influence of the county-level MMP better realized. To control for the wide range of county populations, all admissions and card data were regenerated to be in terms of per 10,000 citizens in the specified county.

The first graph considered was that of Marijuana/Hashish admissions (Graph 1), for this is expected to receive the most direct effects from MMP implementation. The trend line indeed revealed a positive correlation, however, to a very small effect. This supports the general hypothesis that states that any form of marijuana legalization will inevitably lead to increases in marijuana consumption. The trend line did not seem to fit the data very well, as the plotted points revealed many outliers toward smaller rates of card distribution. The most dramatic correlations were that of Heroin admissions (Graph 2) and Crack/Cocaine admissions (Graph 3). Both were positively correlated and had relatively steep trend lines. This would support the theory behind the gateway effect, as use of these harder drugs increase with the amount of MMP implementation. Methamphetamines (Graph 4) also showed positive correlations, but to

even a smaller effect than that of Marijuana/Hashish. Again, one must note that the trend line does not fit the data very well.

The three types of treatment programs were then explored. Positive correlations were found in all three cases, yet all had relatively flat trend lines. Narcotic Treatment Program admissions (Graph 5) had two major outliers that negatively skewed results. Outliers are most likely the result of the graph's vulnerability to the influence of uncontrolled variables, as this type of analysis is very primitive in its nature. Outpatient Treatment admissions (Graph 6) and Residential Treatment admissions (Graph 7) both had a large variance of plotted points toward smaller rates of card distribution, causing poor fits of the trend line. Results may become clearer as additional variables are included in the analysis; there will be a better chance to control for the outliers responsible for skewing results.

I proceeded to run four sets of regressions for each of the seven dependent variables to better explore the specific effects of the MMP. (1) I first ran a regression of treatment admissions on the number of distributed cards. If a county had not yet authorized the distribution of said cards, the card total was marked as "0" in order to reflect the actual number of circulating cards in each county. This would allow us to consider the variation of admission rates when MMP-authorized Medical Marijuana ID Cards were not in effect in certain counties. This also allows for pre-2004 admissions data to be included in the regression, furthering insight into trends before the influence of the MMP. (2) I then ran a regression of treatment admissions on the number of distributed cards and the binary variable "Legal", which denotes whether a county had an active county-level MMP. This will reveal if the sole acceptance of such a program has any effect on drug treatment admissions, as opposed to the effect of the physical amount of cards produced by the program.

(3) My next step was to create two sets of dummy variables to control for possible non-

related effects that specific years or counties may have had on admissions. For example, Santa Cruz has naturally high rates of drug treatment admissions due to socio-cultural influences. However, their high distribution of MMP-approved Medical Marijuana ID Cards may suggest that high admissions are a reflection of the implemented program. To account for this, year and county fixed effects were created for years 2001 through 2007 and for all counties excluding Alameda. (4) Though admission rates and card totals are calculated per 10,000 citizens, I proceeded to include population and population-squared in the fourth set of regressions to control for possible effects that the characteristics of larger counties might have had on general admission rates. For example, crime and homelessness rates in Los Angeles are significantly higher than those in Del Norte, which is most likely reflected by their drug treatment admission rates. Regressions 3 and 4 are expected to be the most reliable of the regressions because of their ability to control for these possible outside effects.

Again, I looked first to the regressions concerning Marijuana/Hashish admissions (Table 2), as it has the closest relevance to the independent variables. Regressions 1 and 2 revealed positive correlations; however, they were not statistically significant. The R-squared values revealed that less than 1% of the results can be explained by the first two models. I looked to regressions 3 and 4 to see if the inclusion of the year and county fixed effects would allow for a better fitting model, and in turn, more conclusive results. The results showed a change from positive to negative correlations and the R-squared values jumped above 85%. The results, however, remained statistically insignificant. This reveals that there is no realized connection between MMP implementation and overall marijuana abuse, which opposes most literature on the subject. This could also mean that most people being distributed marijuana via the MMP are simply using the substance as intended by the physician, which will not significantly increase the rate of abusers. We must understand that movements in the black market cannot be

accounted for, which may independently drive admissions rates on a much larger scale. Medical marijuana is only a fraction of all the marijuana produced in California, so its influence will be hard to clearly identify.

Next, I explored the relationships concerning Crack/Cocaine admissions (Table 3). Regression 1 revealed a positive correlation, but the results were statistically insignificant; less than 1% of the results were explained by the model. In terms of distributed cards, regression 2 revealed a positive correlation with statistical significance at the 99th percentile. This supports the theory behind the gateway effect, saying that increased abuse of Crack/Cocaine (and other hard drugs) will result from increased marijuana consumption. The variable “Legal”, on the other hand, produced a negative correlation with a statistical significance at the 95th percentile. This suggests that the sole act of legalization in each county reduces the abuse of Crack/Cocaine, which represents an opposing substitution effect. Regressions 3 and 4 had R-squared values of over 97%, giving the results high reliability. In terms of distributed cards, both regressions revealed positive correlations with high statistical significance. The magnitude of the coefficients decreased from regression 2, however, implying that there was some year or county effect influencing previous coefficients to increase in magnitude. Relationships with the variable “Legal” were no longer statistically significant. From these results, we can conclude that an increase in card distribution will likely lead to an increase in Crack/Cocaine abuse.

I then explored the regressions pertaining to Heroin admissions (Table 4). Regression 1 revealed a positive coefficient with statistical significance at the 90th percentile, showing that as the number of cards increased, so did admissions due to Heroin abuse. Less than 2% of the results could be explained by this model. Regression 2 also showed a positive correlation with cards, but revealed a negative correlation with the variable “Legal”. Both were statistically significant at the 99th percentile, however, only about 7% of the results can be explained by the

model. Though cards still increase Heroin admissions, the quasi-legal status alone seemed to lower Heroin admissions. This oddity could be a result of the low R-squared value. The most interesting results came from Regressions 3 and 4. Both revealed negative correlations on cards distributed, with a p-value less than 0.01 and an R-squared value greater than 88%. Because this is the most reliable of the regressions, we must accept that as the number of cards increase, Heroin admissions actually decrease. This supports the substitution effect, as Heroin use is being replaced by marijuana use. However, relationships with the variable “Legal” reveal positive correlations, stating that Heroin admissions increase as MMP implementation is activated. This could be an effect of legalization as a promotion of overall drug use, having people connect Heroin use with marijuana use. Therefore, if Marijuana use is “accepted”, this may promote others to more readily use Heroin. Correlations change to negative values as regressions 3 and 4 are added, which means there exists some kind of Heroin related year or county effect that skews admissions data. All things considered, we can conclude that marijuana has a significant effect on Heroin admissions, and that there exists a substitution effect between marijuana and Heroin.

Methamphetamine admissions were tested next on all four regressions (Table 5). In terms of cards distributed, Methamphetamines reflected the same effects as that of Heroin, but results were not statistically significant. With very low R-squared values, the first two regressions revealed positive correlations. Regressions 3 and 4 flipped the sign, and coefficients became negative. Though statistically insignificant, over 83% of the results could be explained by the two models. The variable “Legal” showed positive correlations across the board, but results were also statistically insignificant. This still reveals, however, that no correlation exists between Marijuana use and Methamphetamine use.

The three types of treatments were then considered, with Narcotics Treatment Programs being the first (Table 6). Regression 1 revealed a negative correlation with cards, however, results were statistically insignificant and the R-squared value was below 1%. Regression 2 boosted the R-squared value to 7%, though still relatively low, and the correlation with cards became positive. The only statistical significance was that of the variable “Legal”, as it showed a negative correlation. These results must be considered carefully, for the lack of reliability in the second regression makes the findings questionable. As we move on to regressions 3 and 4, the R-squared value increases to above 92%. This being said, all statistical significance was lost on all levels. The coefficients of both cards and “Legal” were positive, revealing an increase in admissions when the MMP was activated and cards were distributed. However, we must conclude that there is no real connection with MMP implementation and Narcotic Treatment Programs due to the lack of reliability and significance.

I then tested Outpatient Treatments on all four regressions (Table 7). Regressions 1 and 2 revealed positive correlations with cards and the variable “Legal”, though results were statistically insignificant and less than 1% of the results could be explained by the two models. Regressions 3 and 4 flipped card correlations to a negative value, which implies the existence of some kind of year or county effect. The relationship with the variable “Legal” remained positive. Though the R-squared values were above 87%, all results were statistically insignificant. Therefore, we can conclude that the implementation of the MMP has no effect on the type of extended treatment that exists under Outpatient Treatment programs.

The final dependent variable was then tested: Residential Treatments (Table 8). Regression 1 revealed a positive correlation with cards and was statistically significant at the 95th percentile. This would imply that as cards distributed increased, so did the number of hospital admissions. We must question the results’ reliability, though, as the R-squared value remained

below 4%. Regression 2 caused the relationship with cards to lose its statistical significance, however significance appeared with the variable “Legal”. Its positive relationship implies that as the county-level MMP is activated, hospital admissions increase. This could be a result of the gateway effect. Harder, unfamiliar drug use may increase as marijuana use is “accepted” by the state, causing injury to those being careless. Again, we must question the reliability of the results, as merely 11% of the results can be explained by the model. Regressions 3 and 4 have produced significant reliability in accordance with almost all other dependent variables. However, said regressions on Residential Treatment admissions show R-squared values of 62% and 67% respectively, revealing the lack of reliability of the results. The relationship between cards and admissions changed from positive to negative in regressions 3 and 4, which shows that the characteristics of larger populations had an altering effect on the results. This could be because counties with higher populations have larger numbers of hospitals, making it easier for people with drug-related injuries to receive medical attention. The negative correlations with both MMP variables imply that as county-level MMP is implemented, hospital admissions decrease. Again, a substitution effect can be used to explain this relationship, for harder drugs may be replaced by the use of medical marijuana. We must consider the reliability of the results, and understand that more variables must be accounted for in order to produce the most significant results.

DISCUSSION

The implications of the findings in this study are difficult to generalize knowing that there exists an enormous black market for these drugs. Private distribution of marijuana trumps that coming from state-approved medical marijuana dispensaries, and there is no reliable way to determine the fluctuations associated with the illegal trade. Medical marijuana represents only a small fraction of total marijuana consumption, so the trends identified by the regressions in this study may not suitably represent movement in marijuana use. In order to determine the effects with full accuracy, one must obtain legitimate data on total black market distribution and consumption of each of the noted drugs, as well as additional localized census data to control for external influences. To ripen MMP related data, one could obtain the actual amount of marijuana distributed by weight from each of the dispensaries in order to better realize the circulation of the substance. The more localized the data can be within each county, the better the conclusions can be concerning direct health effects as a result of marijuana use. Much of these desired statistics are untapped or the related estimations cannot be relied upon as legitimate reflections of reality. This is why there are so many uncertainties surrounding the effects of marijuana on public elements; the subculture is simply too large.

Another issue is that of our assumptions surrounding marijuana legalization. If it is assumed that marijuana consumption naturally increases as associated laws loosen and said effect can be seen through the number of treatment admissions, then there would be significant positive correlations with MMP activity and treatment admissions for marijuana. Instead, the results showed no statistical significance with marijuana treatment against all variables. This is either a result of poor variable usage or incorrect assumptions concerning marijuana legalization. The lack of historical evidence may be responsible for the inaccurate assumptions,

as we have yet to experience the legalization effect with multiple samples. Of the available examples, such as the Netherlands and Australia, not one matches the exact level of legalization that has been implemented in California. With this in mind, the assumptions made concerning marijuana consumption and legalization could actually be correct when applied to the right level of legalization. They would only be accurate when legalization is applied to an entire range of a population defined by age, not just by making it available for those with medical justifications. In other words, California's MMP may be influencing too small of a demographic to see valid correlations with a set public health data that considers the entire population.

We cannot completely disregard the findings in this study, though, for statistically and economically significant results were produced. Exact implications may be less reliable due to the lack of vital consumption data, but the general effect of marijuana on treatment admissions can be felt by the results. Because positive correlations exist among these statistically significant findings, one can look toward the gateway effect as a viable theory to predict what may ensue post-legislative reform. If reality shows negative correlations, this would imply that there exists some kind of substitution effect with the drugs tested in the study. If addicts of such illicit drugs (Cocaine, Heroin, ect.) can access another type of drug (Marijuana) that is safer both legally and medically, more readily available by a structured market, and yet still produces a "high" when used, abuse of said dangerous drugs may diminish. In turn, you would assume to witness an increase in marijuana consumption rates to account for the act of substituting the drugs.

The literature concerning marijuana legalization is vast; however, there are simply not enough tangible examples in history to show if theory is consistent with reality. Until marijuana use is completely legalized and the black market no longer has a significant effect on consumption, we cannot be sure of the effects that the implementation of programs like the

MMP has on the various public health elements. Times are indeed changing in California, and we must be prepared for the uncertainties that accompany proposed legalization of this magnitude.

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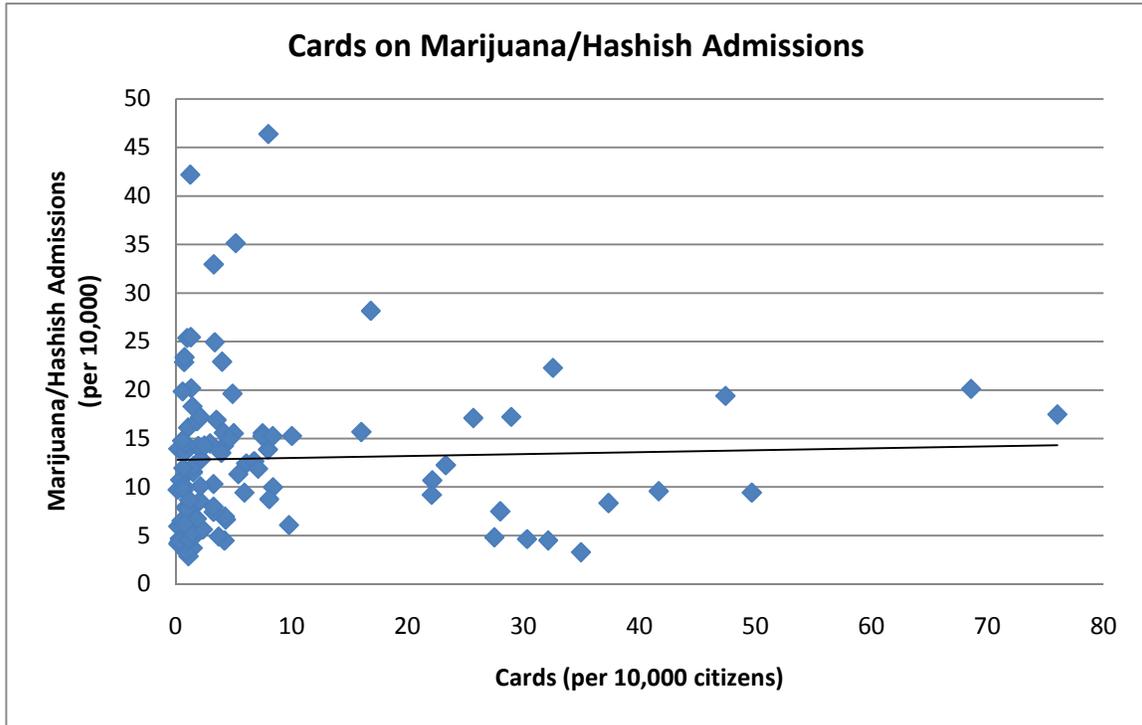
APPENDIX

Table 1

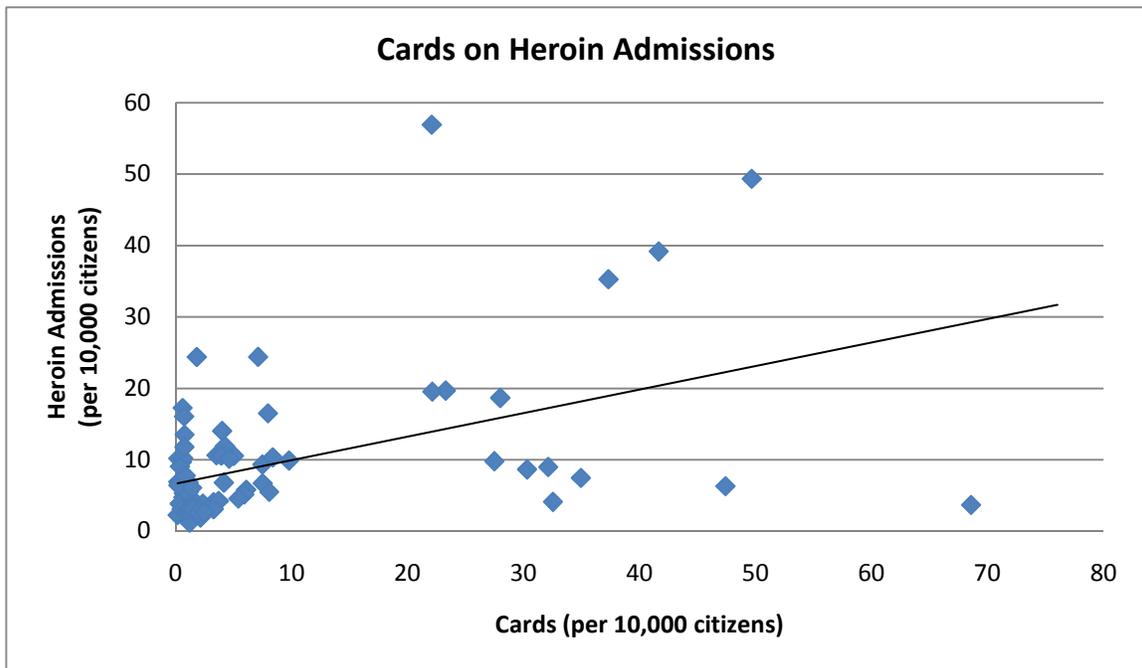
Distributed MMP-approved Medical Marijuana Identification Cards

<i>County</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>Total</i>
Alameda			1475	657	652	2784
Amador	4	23	32	15	16	90
Butte			5	16	33	54
Calaveras		6	19	31	46	102
Contra Costa		22	152	136	162	472
Del Norte	14	49	84	75	47	269
El Dorado				16	28	44
Humboldt		105	306	292	370	1073
Kern		41	72	69	92	274
Lake			8	33	51	92
Los Angeles				401	667	1068
Marin		692	887	773	824	3176
Mendocino	67	428	683	614	292	2084
Merced			4	17	17	38
Monterey				9	47	56
Napa		16	28	44	29	117
Orange				114	269	383
Placer				11	37	48
Riverside		265	460	374	680	1779
San Francisco		1751	3975	3383	3118	12227
San Luis Obispo			52	79	59	190
San Mateo		267	586	433	398	1684
Santa Barbara		147	314	176	168	805
Santa Clara		88	581	172	213	1054
Santa Cruz		191	400	240	222	1053
Shasta				48	189	237
Sonoma		26	38	35	45	144
Tehama		6	20	8	21	55
Tulare			25	31	33	89
Ventura					62	62
<i>Total Count</i>						31603

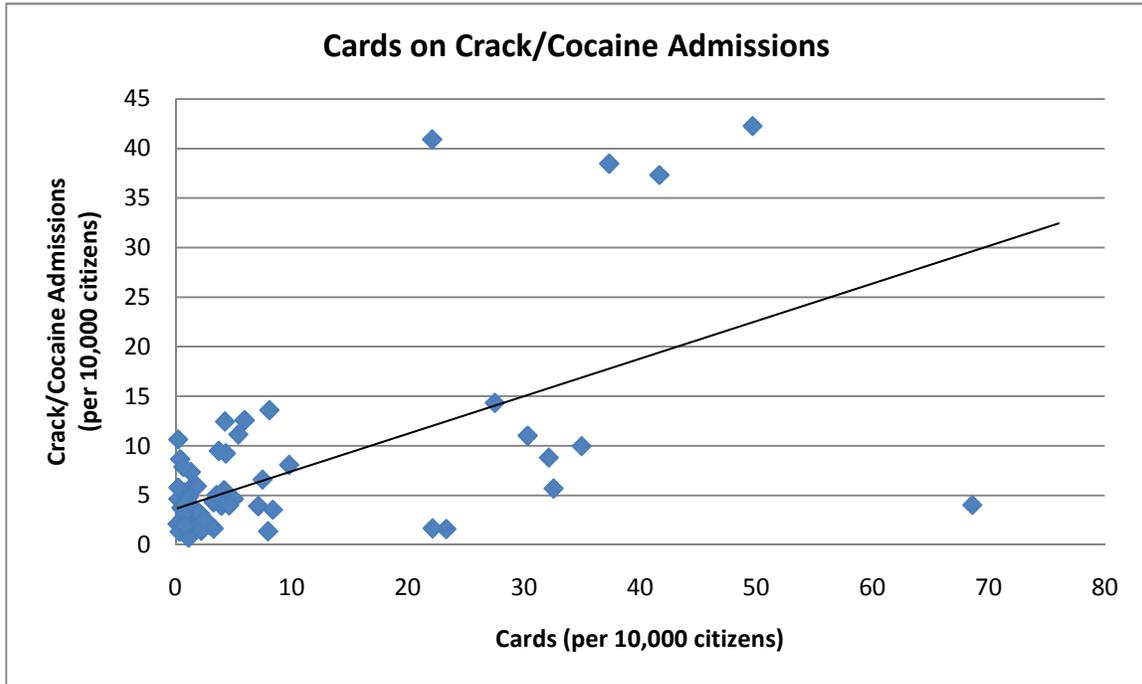
Graph 1



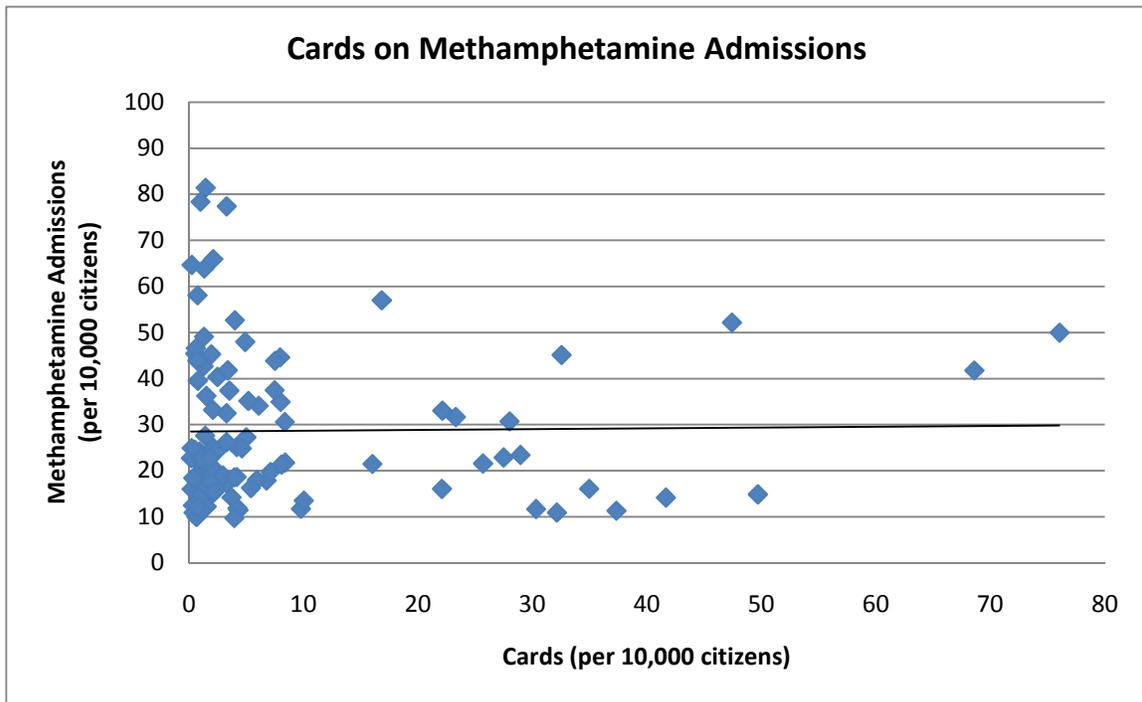
Graph 2



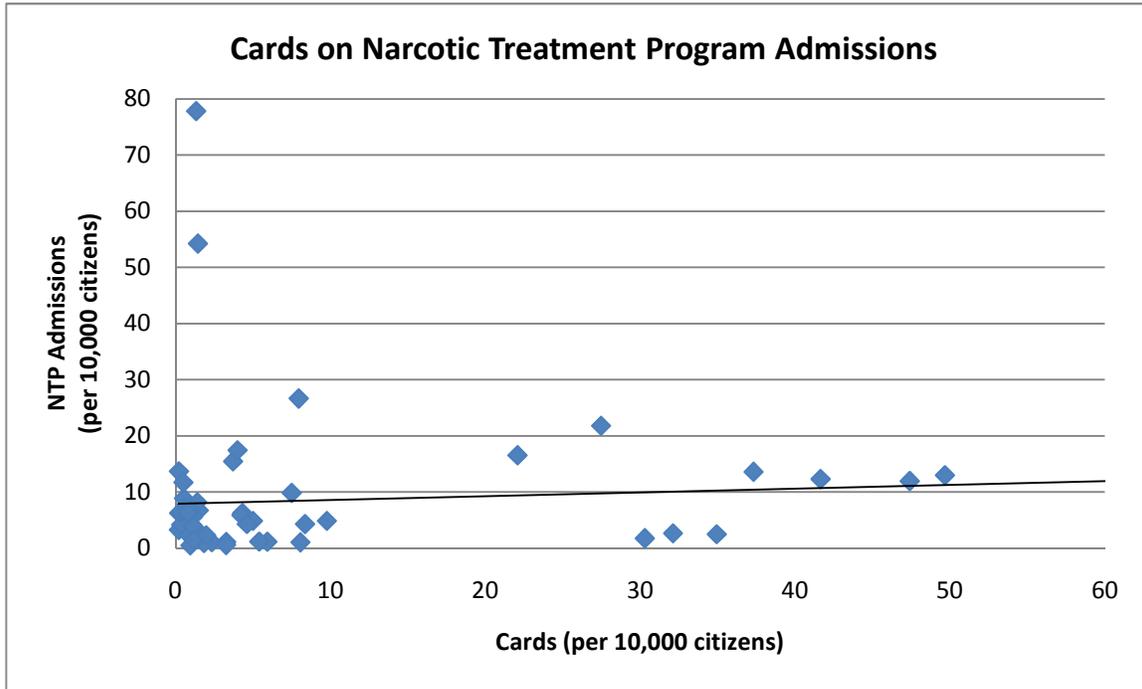
Graph 3



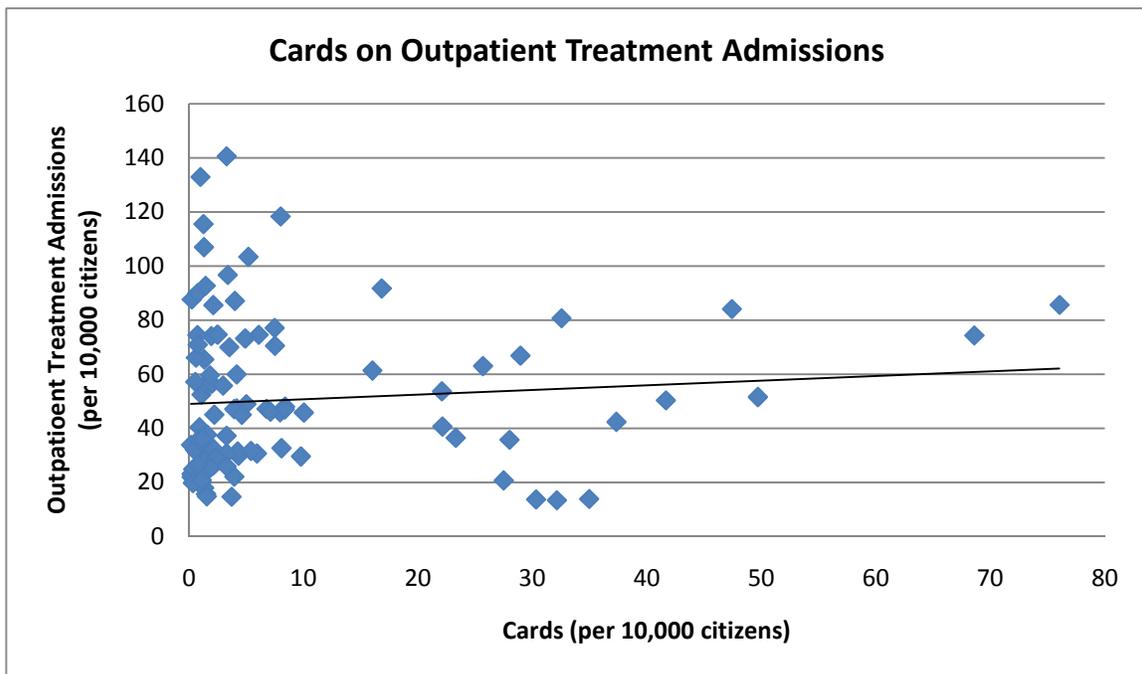
Graph 4



Graph 5



Graph 6



Graph 7

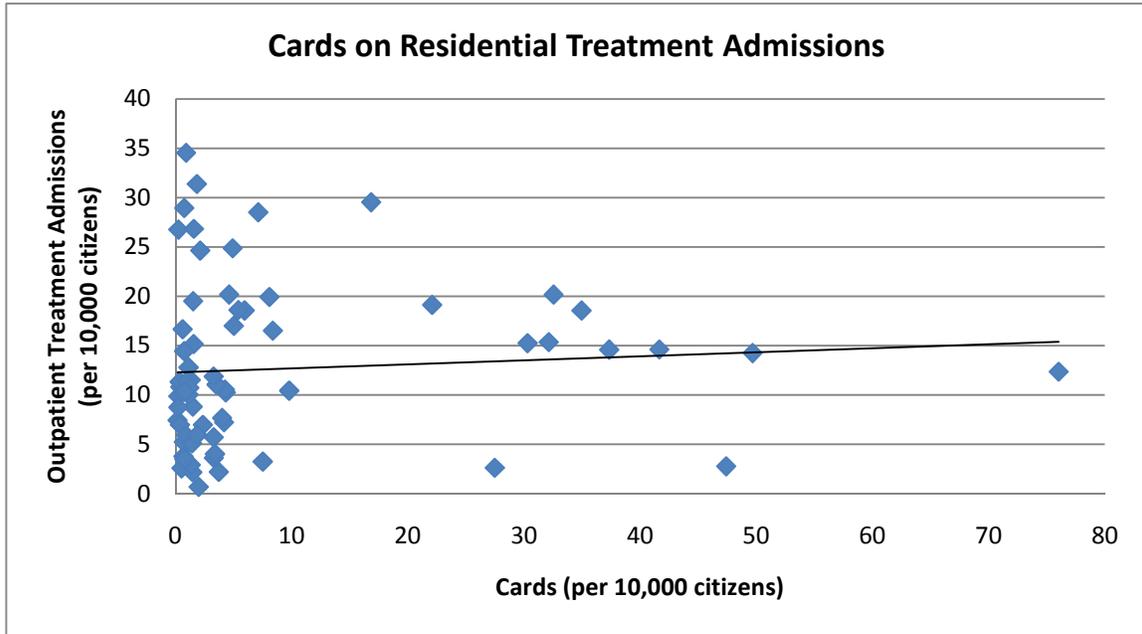


Table 2

Marijuana

	(1)	(2)	(3)	(4)
Cards	.029 (.050)	.019 (.055)	-.022 (.029)	-.017 (.030)
Legal	-	.494 (1.165)	.349 (.908)	.465 (.909)
Population	-	-	-	.000 (.000)
Population ²	-	-	-	.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0015	.0023	.8693	.8711

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 3

Crack/Cocaine

	(1)	(2)	(3)	(4)
Cards	.319 (.055)	.378*** (.059)	.052*** (.016)	.049*** (.017)
Legal	-	-2.626** (1.085)	-.218 (.469)	-.227 (.472)
Population	-	-	-	-.000 (.000)
Population ²	-	-	-	.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0015	.1655	.9704	.9706

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 4

Heroin

	(1)	(2)	(3)	(4)
Cards	.177* (.097)	.329*** (.104)	-.217*** (.054)	-.233*** (.055)
Legal	-	-6.911*** (2.027)	.999 (1.599)	.954*** (1.605)
Population	-	-	-	-.000 (.000)
Population ²	-	-	-	.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0162	.0697	.8825	.8840

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 5

Methamphetamines

	(1)	(2)	(3)	(4)
Cards	.054 (.101)	.017 (.112)	-.009 (.068)	-.017 (.069)
Legal	-	1.806 (2.347)	2.184 (2.069)	2.291 (2.082)
Population	-	-	-	-.000 (.000)
Population ²	-	-	-	
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0012	.0037	.8316	.8325

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 6

Narcotics Treatment Program

	(1)	(2)	(3)	(4)
Cards	-.173 (.149)	.067 (.162)	.021 (.065)	.037 (.066)
Legal	-	-9.519*** (2.809)	1.628 (1.633)	1.567 (1.639)
Population	-	-	-	.000 (.000)
Population ²	-	-	-	-.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0075	.0690	.9297	.9307

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 7

Outpatient Treatment

	(1)	(2)	(3)	(4)
Cards	.215 (.174)	.172 (.192)	-.086 (.099)	-.088 (.102)
Legal	-	2.137 (4.016)	2.721 (3.027)	3.009 (3.042)
Population	-	-	-	-.000 (.000)
Population ²	-	-	-	.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0065	.0077	.8774	.8783

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1

Table 8

Residential Treatment

	(1)	(2)	(3)	(4)
Cards	.128** (.052)	.041 (.055)	.012 (.053)	-.029 (.051)
Legal	-	4.344*** (1.124)	-.328 (1.589)	-.268 (1.515)
Population	-	-	-	-.000 (.000)
Population ²	-	-	-	.000 (.000)
County Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
R ²	.0336	.1087	.6235	.6654

(Standard errors in parentheses), *** p<0.01, ** p<0.05, * p<0.1