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Evaluating Medical Marijuana Dispensary Policies: Spatial Methods for the Study of Environmentally-Based Interventions

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Abstract

In 1996, California was the first state to pass a Compassionate Use Act allowing for the legal use of marijuana for medicinal purposes. Here we review several current policy and land use environmental interventions designed to limit problems related to the influx of medical marijuana dispensaries across California cities. Then we discuss the special challenges, solutions, and techniques used for studying the effects of these place-based policies. Finally, we present some of the advanced spatial analytic techniques that can be used to evaluate the effectiveness of environmental interventions, such as those related to reducing problems associated with the proliferation of medical marijuana dispensaries. Further, using data from a premise survey of all the dispensaries in Sacramento, this study will examine what characteristics and practices of these dispensaries are related to crime within varying distances from the dispensaries (e.g., 100, 250, 500, and 1000 feet). We find that some security measures, such as security cameras, having a door man outside, and having signs requiring an ID prescription card, taken by medical marijuana dispensary owners might be effective at reducing crime within the immediate vicinity of the dispensaries.

Key words: environmental interventions, marijuana dispensaries, medical marijuana, Bayesian space-time models

Background

In 1996, California was the first state to pass a Compassionate Use Act, which allowed the legal use of marijuana for medicinal purposes. Since then, 15 states and the District of Columbia have passed similar legislation (2011). Municipalities have designed and legislated a variety of regulations in response to a perceived influx of crime and problems in and around these medical marijuana dispensaries (California Police Chief's Association, 2009). These include environmental interventions limiting density of dispensaries based on population, land use ordinances, building codes and permits, and limiting hours of operation. Despite regulating dispensaries through many of these environmental interventions, no empirical studies have been conducted that examined how the characteristics of these dispensaries and their environmental contexts are related to increased crime. Another complicating factor is that while some states have legalized the use of marijuana, the classification has not changed at the federal level. Thus the use of marijuana for any purpose is deemed illegal by the federal government.

Further, despite the increasing number of states legalizing marijuana for medicinal purposes, there remains a dearth of research examining the effects of these policies on local communities. In California's case, regulating the dispensaries has been tasked to local jurisdictions. Throughout the state of California, cities and counties are struggling with developing ordinances to regulate dispensaries through land use polices or taxation through business permits. Yet, the lack of empirical research on the issue means that the effects of these policies to reduce problems thought to be associated with medical marijuana dispensaries (MMDs) are largely unknown.

Here, we will first review several current policy and land use environmental interventions designed to limit problems related to the influx of medical marijuana dispensaries across various states and in California cities. Then the special challenges, solutions, and techniques used for

studying the effects of these place-based policies will be discussed. Next, we will present advanced spatial analytic techniques available to evaluate the effectiveness of environmental interventions, specifically those related to reducing problems associated with the proliferation of medical marijuana dispensaries.

The final section of this paper uses data from a premise survey of all dispensaries operating in Sacramento, California to examine what characteristics and practices of these dispensaries are related to crime within varying distances from the dispensaries (e.g., 100, 250, 500, and 1000 feet). Features of the local environment or specific practices by dispensaries themselves may reduce the likelihood that they become a target of crime (e.g., bright night lighting, minimal signage, additional safety precautions). Thus, this survey of premises around each dispensary examines how the local context of these dispensaries may encourage or inhibit localized criminal activity.

Theoretical Approaches Relating Medical Marijuana Dispensaries to Crime

Three theoretical approaches are relevant to the problems often thought to be associated with MMDs: routine activities, availability, and niche theories. Routine activities theory purports that three conditions must be met for crimes to occur: convergence of a suitable target (here, the dispensaries and their clients), a motivated offender, and the lack of suitable guardians (Cohen & Felson, 1979). The cash and carry nature of the business and the fact that they sell a substance (marijuana) which is illicit for non-medical users makes the dispensaries targets of crime (California Police Chief's Association, 2009). Clients, who may be frail due to the debilitating medical conditions that lead them to use marijuana and carrying large amounts of cash to the dispensary, may also be targets for motivated offenders. Further, lack of security measures, marketing to population prone to participating in crime (i.e., young males) or being

located in a socially disorganized neighborhoods characterized by high residential turnover and concentrated disadvantage may further put dispensaries at risk for crime as those areas are likely to lack place managers (i.e., suitable guardians). Recent studies suggest that offenders will travel some distance to participate in crime at such locations (Tita & Griffiths, 2005), and violence surges, particularly in relatively safe areas, will create adverse effects on businesses in the area (Greenbaum & Tita, 2004).

Availability theory refers how drug distribution systems affect use and problems (Gruenewald, Remer, & Treno, 2008; Holder, 1998; Stockwell, Gruenewald, Toumbouro, & Loxley, 2005). Many environmental interventions are designed to reduce aspects of availability with the ultimate goal of reducing problems. Physical availability refers to the location of dispensaries as well as the ease of access for nearby populations of users and the ease with which through traffic flows. Economic availability refers to how prices affect the use of marijuana and subsequent crimes. Social availability is the ways in which users obtain medical marijuana through the use of their social networks. Finally, legal availability refers to the conditions under which marijuana dispensaries and marijuana use are regulated by various jurisdictions.

Our final theoretical approach that addresses why problems may occur can be found in theories related to niche marketing. Niche marketing suggests that dispensaries owners select the types of clients they wish to use their services through their marketing practices in order to increase market share (Dalgic, 2006; Gruenewald, 2007, 2008). The proliferation of these dispensaries across cities and states increases competition among dispensaries to “recruit” customers. Under these circumstances owners may try to market to specific types of user (i.e., chronic pain sufferers, HIV/AIDS patients) to maintain a core group of users needing their services (Anderson, 2006; Turow, 2006). This increased competition could lend itself to

marketing to non-medical users. Crime and other problems may develop if certain populations are seen as more vulnerable (i.e., suitable target per routine activities theory). Environmental interventions that seek to limit dispensaries across areas or rely on a pharmaceutical model to distribute medical marijuana may reduce the need for this sort of marketing and competition.

Review of Environmental Approaches used to Regulate Dispensaries

State-wide licensing of medical marijuana dispensaries and associated regulations exist in eight out of the sixteen states that allow marijuana for medical use (National Organization for the Reform of Marijuana Laws, 2011). Table 1 and Table 2 detail place-based policies associated with these state-level regulations (Table 1) and local level regulations (Table 2) of medical marijuana dispensaries.

---INSERT TABLES 1 AND 2 ABOUT HERE---

At the state-level, the numbers of dispensaries are limited by controls on densities by local jurisdictions. Thus although the majority of the states require a state license, local entities can determine how many or how few dispensaries are allowed to operate in their county or region. Only one state (Arizona) controls the entire density of dispensaries across the state allowing one dispensary per every ten registered pharmacies, limiting the number of dispensaries to below 125 for the entire state (Arizona Medical Marijuana Act, 2010).

The majority of states with licensing programs mandated distance buffers ranging from 300 feet to 1,000 feet between MMDs and places associated with vulnerable populations, such as schools and child care facilities. In New Mexico, The Lynn and Erin Compassionate Use Act of 2010 also applied a 300 foot buffer around places of worship. These policies are designed to limit geographic availability of medical marijuana.

A “security plan” or evidence of “adequate security” measures are required for all states that have a licensing program. In addition, 75% of the states with licensing policies mandate the use of an alarm system. This requirement remains vague however since only Colorado specifies any security measures outside of an alarm system (e.g., 24 hour close-circuit cameras, safe for storage, outdoor lighting).

Less common at the state level are other site-specific requirements. Only two states, Colorado and Vermont, regulate hours of operation, with Vermont’s regulation specifying patients can be seen by appointment only. Guidelines for daily operations across states are usually limited to prohibiting on-site consumption of marijuana products. In all cases, states defer authority to local jurisdictions to impose restrictions (or more severe restrictions) upon MMD locations, security, hours, and other operations.

More details on measures designed to regulate business practices of medical marijuana dispensaries are provided at a local jurisdiction level. Policies regulating MMDs at the local-level are predominant in the regulated states of Arizona, Colorado, and Maine and in the unregulated states of California, Michigan, and Washington. Density controls tend to be conducted through the use of moratoriums on dispensaries opening (Medical Marijuana Dispensary Standards, 2011; Sacramento Ordinance 2009-033, 2009) and limits per population (Legalization of Marijuana for Medical Treatment Amendment Act, 2010; Los Angeles Ordinance No. 181069, 2010). Moratoriums on new dispensary locations usually occurs when concerns of MMD proliferation mount and are often a precursor to more strict regulations. Thus moratoriums allow communities time to determine the appropriate manner with which to limit MMDs and associated social issues.

Zoning restrictions are more clearly defined in local-level policies, with dispensaries predominantly zoned for commercial areas (Ann Arbor Ordinance No. ORD-10-37, 2010; La Paz County Ordinance No. 2011-02, 2011; Phoenix Ordinance G-5573, 2010; Sacramento Ordinance 2010-038, 2010) or more general restrictions of not being allowed to operate in residentially zoned areas (Denver Council Bill No. 34, 2010; Legalization of Marijuana for Medical Treatment Amendment Act, 2010).

Some jurisdictions also have imposed distance buffers around residential zones that range from 300 feet to 1,000 feet (Los Angeles Ordinance No. 181069, 2010; Phoenix Ordinance G-5573, 2010; Sacramento Ordinance 2010-038, 2010). These distance buffers are designed to limit geographic availability as well as reduce problems typically assumed to co-occur in proximity to dispensary locations, such as crime. In regulated states, such as Arizona, some local jurisdictions have increased distance buffers around schools and child care facilities beyond what is required by the state, ranging to as high as 820 feet more than state regulations (e.g., La Paz County Ordinance No. 2011-02, 2011; Phoenix Ordinance G-5573, 2010; Tempe Ordinance No. 2011-01, 2011; Youngtown Ordinance No. 11-02, 2011).

Buffers between MMDs are common and range from 500 feet to 1,000 feet (Denver Council Bill No. 34, 2010; La Paz County Ordinance No. 2011-02, 2011; Los Angeles Ordinance No. 181069, 2010; Sacramento Ordinance 2010-038, 2010). Phoenix, however, is an extreme case requiring 5,280 feet (~ a mile) between MMDs (Phoenix Ordinance G-5573, 2010). Niche theory suggests that the likely effect of regulating the distance between dispensaries is the minimizing of marketing to different segments of the population when seeking to increase market share and profit rates. With fewer dispensaries overall from which patients can shop,

MMDs located in jurisdictions with distance buffers may not need to market to “non-medical” users to increase revenues.

A few local jurisdictions have extended the application of distance buffers to other places where vulnerable populations frequent. For example, La Paz County Ordinance No. 2011-02 indicated no dispensary can be located within 500 feet of parks, libraries, places of worship, signed school bus stop, alcohol outlets, and sexually-oriented businesses. Alternatively, Sacramento Ordinance 2010-38 established a 600 foot buffer around any park, youth-oriented facility, church/faith congregation, drug treatment facilities, movie theater cinema, or tobacco store.

Where no state-wide regulations exist, local jurisdictions have utilized a variety of policy approaches. In Washington, Spokane does not recognize the legality of MMDs, ordering all existing ones to shut down (Cuniff, 2011) while Seattle on the other hand has imposed regulations limiting their proliferation (Seattle Ordinance No. 123661, 2011). Local jurisdictions in California have varied in approaches including imposing place-based regulations as shown in Table 2 (e.g., Sacramento Ordinance 2009-033, 2009; Sacramento Ordinance 2010-037, 2010; Sacramento Ordinance 2010-038, 2010), explicitly banning dispensaries (e.g., Burbank; Kellam, 2011), or not actively regulating dispensaries at all (e.g. San Diego repealed regulations in July 2011; Kuhney, 2011). Finally, pending Court cases and rulings in some states, such as California and Michigan, have both stymied the enforcement of regulations and placed pressure upon dispensaries to close (Hoeffel, 2011; White, 2011)

Complicating this picture of local and state regulatory efforts is that effectiveness of the procedures being implemented (e.g., moratoriums) is not always known. The following section examines the research evidence on the effectiveness of many of the environmental interventions associated with regulating these dispensaries.

Review of Effectiveness of Environmental Approaches

Location restrictions, such as zoning codes and distance buffers, have long been used to segregate activities and control for negative externalities. More recently, zoning restrictions have been used to protect residential populations from secondary effects such as crime and the increased availability of unfavorable or controversial products associated with businesses that sell alcohol, tobacco, firearms, fast food, and pornography (Ashe, Jernigan, Kline, & Galaz, 2003; Holder, et al., 2000; Papayanis, 2000). In a multi-stage community trials intervention, Holder et al. (2000) observed a decrease in high risk drinking and alcohol-related injuries when zoning regulations and distance buffers between alcohol outlets and public places, such as schools and parks, effectively limited alcohol access. However, a major critique of these practices is that policies such as these contribute to the marginalization and ghettoization of social space by keeping "unwanted" individuals and businesses out of more affluent residential communities (Papayanis, 2000).

---INSERT TABLE 3 ABOUT HERE---

Crime prevention through environmental design (CPTED) approaches target design and operational aspects of business through surveillance, access/control, and territoriality of place. The effectiveness of CPTED approaches is difficult to measure due to lack of controls and the multi-component nature of most interventions (Casteel & Peek-Asa, 2000; Cozens, Saville, & Hillier, 2005; Mair & Mair, 2003). Overall, multiple component interventions were associated with higher reductions in robberies than in comparative locations (30% to 84% decrease), with the highest reductions for those sites that used individualized security plans (Casteel & Peek-Asa, 2000; Mair & Mair, 2003). In fact, Loomis et al. (2002) found the odds of workplace homicide decreased with the presence of bright exterior lighting, security alarms, cash drop

boxes, and the implementation of at least five environmental measures (e.g., barriers, video cameras). Other single component interventions found to be effective include: employing a second clerk, locked entrances, installation of security hardware, and hiring guards (Casteel & Peek-Asa, 2000; Cozens, et al., 2005; Loomis, et al., 2002). Policies/ordinances regulating CPTED practices were also associated with a decrease in robberies post-intervention (Casteel & Peek-Asa, 2000). Casteel & Peek-Asa (2000) found in a review of the literature on CPTED that individualize security plans helped to effectively reduce crime. This requirement is popular among state-level regulations on MMDs. Additionally, since the majority of crimes occur between the late afternoon and early morning hours (Felson & Poulsen, 2003), limiting access by regulating dispensaries operating hours may reduce crime as well.

Although these approaches have not been studied explicitly with medical marijuana dispensaries, evidence exists that suggests these approaches might reduce problems in areas where these dispensaries are located. However, studying the effects of environmental change can be difficult due to a variety of reasons, often resulting in a dearth of information about their effectiveness. Next, we discuss a variety of strategies that can be used in determining the efficacy of such interventions to reduce problems and also note some of the difficulties in such studies.

Analytic Methods for Studying Environmental Change of Medical Marijuana Dispensaries

Natural Experiments. The use of natural, quasi-experiments to study the effects of changes in crime and other related problems because of the introduction of medical marijuana dispensaries became possible recently as several California cities and many states enacted ordinances restricting the density and location of dispensaries. These changes were designed to affect legal and physical availability of marijuana through dispensaries. These policies and

changes in practices have created an opportunity to estimate the effects of dispensaries on a variety of social problems—including crime. For example, both the city of Los Angeles and Sacramento have passed legislation in 2010 that limited the density of dispensaries based on population and regulated the locations in which dispensaries could operate (e.g., cannot be within 1000 feet of schools) in response to the rising number of MMDs. By 2010 the number of cannabis dispensaries in Los Angeles almost tripled from 186 in 2007 to 545 while in Sacramento the number grew to around 40 from the 14 operating in 2006. Law enforcement officials cite concerns about increases in crime rates due to the rising number of dispensaries (California Police Chief’s Association, 2009). Similarly, the increase in dispensaries may segment client populations at dispensaries that make them more vulnerable to victimization as is suggested by niche theory presented above.

Analyses of the effects of these policies can examine conditions before and after the policy was enacted. As such, studies would be longitudinal in nature and rely on the collection of readily available archival data, including police incidents of violent and property crimes and hospital discharge data related to cannabis abuse and dependence. This approach has been used previously to study extreme reduction in alcohol outlet densities due to civil unrest in Los Angeles County (Cohen, et al., 2006) and policies designed to reduce the physical availability of methamphetamine in California (Gruenewald, et al., in review) and provides valuable information on how to study how problems change when environmental approaches to reducing problems are enacted.

Natural experiments or quasi-experiments are attractive for several reasons. First, they provide the opportunity to compare a period before the event occurred (i.e., enacting of a policy) to one after it to ascertain whether or not changes in problem behaviors occurred. Second, many

of these experiments occur in areas large enough to provide sufficient power to test whether or not the intervention resulted in change. One such experiment occurred in California when laws governing the sale of ephedrine or pseudoephedrine (a precursor chemical in the making of methamphetamine) were enacted (Gruenewald, et al., in review). Changes to regulations governing medical marijuana dispensaries often occur across entire cities or states. Finally, through the use of archival data (often collected by local agencies without the express intent of using them for research), evaluations of naturally occurring environmental interventions are often completed with less expense than evaluations of individually-based interventions. By utilizing data collected by other entities on crime (police departments), health conditions (from hospital discharges), or a variety of other social problems, fewer resources are needed to study potential effects of these interventions.

Spatial Methods. By definition, environmental interventions are about changing environment or place characteristics. Thus, this issue of place must be adequately addressed when studying the effects of these interventions. A common feature and strength of the two examples cited above is their utility when using specialized spatial methods to study the effects of changes in the environment. Two important considerations in determining how best to evaluate these place-based strategies is to think critically about how and why places may be connected to each other and then to find ways to model that relationship as part of the analytic strategy.

The first consideration is to determine how place or location should be measured. This will depend, in part, on how the policy or intervention being implemented purports to change place. Limits to densities of MMDs will use some measure of density as the unit of analysis. Here, one will need to pay attention to whether density has been prescribed per some areal unit

(e.g., zip code, city) such as in Washington D.C. or by population size (e.g., per 10,000 population) as is the case in Los Angeles. In absence of this information, decisions about how to determine the appropriate density unit must be made. More information is provided about this decision-making process in the next section of the paper.

Implementations of buffers around dispensaries will require information about how far-reaching across areas the effects of negative consequences or outcomes are. If crime or other problems are higher near dispensaries is this true at 200 feet? 500 feet? 1500 feet? Similarly if security measures are required by dispensaries to reduce problems, how local or far should these reductions in crime be seen? Empirical observations of these relationships need to be conducted so that environmental interventions are implemented using the best available evidence that will ensure their effectiveness.

Concerns about the location of places during statistical analysis arose because of spatial autocorrelation or that places located next to each other are likely to be similar to each other (Cliff & Ord, 1973, 1981). Any application of these methods to studying environmental interventions must assess and control for spatial correlation found in the models. This can be accomplished in a number of different ways. Cohen and colleagues (2006) accounted for spatial autocorrelation by detecting levels of geographic clustering and adjust tests of significance to include these assessments of spatial autocorrelation. More recently, attention has been directed away from controlling for spatial autocorrelation and towards determining more completely how space might matter. Here, the purpose is to determine whether some diffusion process might be occurring to spread problems across adjacent areas (Freisthler, Lery, Gruenewald, & Chow, 2006). Gruenewald et al. (in review) use Bayesian conditionally autoregressive (CAR) space-time analyses in their study of the spread of methamphetamine problems across California.

Using these procedures, the authors' model how changes occur over time and space in reaction to environmental changes related to reduced availability. Here time trend variables allow for the assessment of changes in legislation governing the distribution of products used in the manufacturing of methamphetamine. Although computationally intensive to implement, the benefits for assessing the effective of environmental interventions are great. Use of these models can identify specific geographic areas that are more or less responsive to environmental interventions (Waller, et al., 2007). Thus the use of these advance spatial methods represents both an advancement of the science and an increased opportunity to understand and document the effects of environmental change. Yet challenges still exist in the study of these types of interventions,

Challenges to Studying Environmental Change. Environmental policies are often difficult to study for many reasons. Environmental change often occurs over an entire jurisdiction meaning that the “recipients” of such change are whole communities, cities, or states. To understand the effects of policies designed to elicit change, decisions must be made about the appropriate geographic level at which the changes are expected. Are the environmental strategies designed to change the structure of neighborhoods, such as policies designed to limit densities of various business establishments? If so, the unit of analysis for measurement may be “neighborhoods” which can be measured using a variety of administrative units (i.e., Census tracts) or locally defined boundaries. Some policy interventions are designed to reduce problems at the state level. To assess effectiveness in this case, a time series design examining the changes in problems before and after the policy intervention. This approach requires the availability of many years of data to ensure sufficient statistical power to ascertain whether reductions in problems occurred. Still other environmental strategies are targeted at much smaller areas:

individual neighborhood areas or specific business establishments. These require different assessments of the spatial relationships. For example, multivariate analyses at the dispensary level might need to take into account the distance of each dispensary from every other dispensaries, with those being close to each other have more weight (e.g., distance matrices see Freisthler, et al., 2006). Thus deciding the correct level at which to evaluate the effectiveness of environmental interventions is an important step to studying the effects of those changes.

An additional consideration in determining the effectiveness of environmental interventions is in how the interventions are implemented. With many policies regarding medical marijuana dispensaries, several pieces of interventions are introduced simultaneously (e.g., density restrictions, security requirements) making it difficult to determine the efficacy of any single component of an intervention. As discussed earlier, many of these multi-faceted interventions may be effective; however, without the ability to conduct randomized controlled trials of the interventions components, it is difficult to know which parts are crucial to create change and the relative impact of each component. Thus reliance on quasi-experimental methods or case-control studies increases, requiring creative, but imperfect, ways of understanding how individual components of an intervention may contribute to the whole. For example, in Sacramento, many different security measures of medical marijuana dispensaries are required, but not all dispensaries implemented these measures at the same time. This allows us to examine those dispensaries with the various security features to those that do not have them and make preliminary assessments of likely effectiveness.

Sacramento: A Case Example

California was the first state to approve the use of cannabis for medical purposes in 1996 via Proposition 215. Essentially this legislation changed the Health and Safety Code so that

cannabis was no longer classified as a Schedule I drug (i.e., illicit, highly addictive, and no medicinal purposes) to Schedule II (i.e., high potential for abuse but has accepted use as medical treatment) in the state. Although the first dispensaries began operating approximately at the same time, they were quickly raided by the Drug Enforcement Agency and closed (Daley, 1997). In July 2009, Sacramento declared a moratorium on new dispensary locations and required dispensaries to register with the city. Sacramento passed Measure C in November 2010 which allowed the city to levy substantial taxes (over \$15,000 per year) specific to dispensaries.

Williams and Freisthler (in review) found no relationship between densities of dispensaries and violent or property crimes in Sacramento. Relying on the routine activities framework, this finding suggests that one of the conditions (suitable target, motivated offenders, or lack of suitable guardians) was not met in order for higher levels of crime to occur. In fact, crime rates were observed to increase in areas surrounding dispensaries immediately after they closed (Jacobson, et al., 2011). One possible explanation provided is that dispensaries provide adequate levels of security that help to deter crime in areas immediately surrounding them. However, present studies have not systematically evaluated the specific security measures implemented by dispensaries and associated crime incidents surrounding these locations. Given that the majority of policies require adequate security at dispensaries with some going so far as to specify the types of security features needed, we examined how the presence or absence of a variety of security measures may be related to crime at various distances from the dispensaries.

Methods. We conducted premise survey at each dispensary in Sacramento between December 2010 and February 2011 using pretested protocols (Freisthler, Gruenewald, Treno, & Lee, 2003; Paschall, et al., 2007). These surveys provided important information about the

locations where these dispensaries are located and about their specific practices that may reduce problems associated with them.

Sampling and Data Collection Methods

A list of medical marijuana dispensaries located within the city limits of Sacramento was compiled from listings in local newspapers. Each location was visited to determine its status, hours of operation, type of business model (e.g., pharmacy, social club), exterior condition, information about the immediate area, interior maintenance, and the security measures used.

External characteristics of the dispensary and neighborhood were observed prior to entering the location. Upon entry, the internal characteristics of the dispensary and the patrons were noted. No purchases were made or samples accepted during the visit. The premise surveys were completed after exit and prior to arriving at the next location.

Dispensaries closed at the time of the visit, appearing to be out of business, or that could not be located received a follow up visit to determine their status and to conduct the premise survey if located. Five locations (9.8%) were removed from the list when it was determined that they had either moved outside the city limits or were found to be a prior addresses of other dispensaries on the list. Fifteen dispensaries were no longer in business. All 31 dispensaries (67.4%) in business at the time of visit were successfully surveyed and their addresses geocoded.

Measures

Violent crime. The dependent variable for this study is the number of violent crimes within various distances around the medical marijuana dispensaries. Data on violent crimes for the year 2000 were obtained from the Sacramento Police Department website which archives all incidents of crime on an annually basis. Here, violent crime includes homicide, assaults, robbery, and aggravated assaults. Ninety nine percent of all violent crimes were geocoded to the

street address or intersection where the incident occurred. The number of violent crimes within 100, 250, 500, and 1000 feet radius of each of the dispensaries was then calculated. This provided a measure of extremely local crime and more distal crime around the locations of the dispensaries.

Security measures. During the premise survey, information on visible security measures was recorded. These included the presence or absence of a doorman, a locked metal screen door, a pass through on the door, security cameras, and signs stating that a doctor's recommendation and id card were necessary for entry.

Data Analysis Procedures

Data were analyzed using t-tests comparing the average number of violent crimes for dispensaries that have each type of security measure versus those that did not. We analyze the relationship between violent crime and security measures utilized by dispensaries at 100, 250, 500, and 1000 feet buffers around the dispensaries. Given the small sample size and the exploratory nature of this analysis, we use $p < .10$ as the significance level.

Results. Figure 1 shows the bivariate comparison of MMDs who employ various security strategies with those who do not within 100, 250, 500, and 1000 feet buffers of the dispensaries. Dispensaries with security cameras and signs requiring an identification prescription card had significantly lower levels of violence within 100 and 250 feet. Having a door man outside was related to lower levels of crime at 250 feet. There was no relationship between having a pass through on the door and violent crime. Conversely, dispensaries with a screened metal door had a significantly higher average of violent crime than those dispensaries without a screened metal door within a 500 foot radius. No other security measures were related to number of violent crimes at the 500 and 1000 foot radius levels.

---INSERT FIGURE 1 ABOUT HERE---

Discussion. The preliminary findings show that some security measures, such as security cameras, having a door man outside, and having signs requiring an ID prescription card, taken by medical marijuana dispensary owners might be effective at reducing crime within the immediate vicinity of the dispensaries. However, dispensaries with locked metal doors had higher crimes within 500 feet radius. This finding may be more indicative of the location of the dispensary than crime related to the dispensary itself. In other words, dispensaries located in high crime areas may already have locked metal doors on the building from previous tenants to ward against crime in this high crime areas. These findings are limited by the small sample size and cross-sectional nature of the data in one location. Despite this, they point to some interesting, relatively inexpensive, measures that can be taken that might result in lower levels of crime within the immediate vicinity of medical marijuana dispensaries.

Implications for Evaluating Environmental Change Strategies. These findings suggest that some security measures might be more likely to reduce crime rates than others. Further that certain environmental security measures showed lower levels of crime with the limitations of a small, cross-sectional sample, provide encouraging evidence that requiring these measures in all dispensaries might help to reduce violent crime. In terms of evaluating larger effects of environmental change, the methods described earlier suggest that continuing to monitor these dispensaries over time, along with increased implementation of security measures in more dispensaries, provides a natural setting with which to determine the long-term efficacy of such policies.

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Table 1: State-Wide Medical Marijuana Dispensary Regulations

State	State Licensing Legislation	School Buffers	Density Controls	Security Measures	Hours of Operation	Operations
Arizona	Arizona Medical Marijuana Act (2010)	500 ft	1 per 10 pharmacies	Alarm System , “Adequate Security” to Prevent Theft		No On-site Consumption
Colorado	Colorado Medical Marijuana Code (2010)	1,000 ft		Alarm System, Cameras, Lighting, Safe for Storage of Cash/ Marijuana	7AM – 9PM	No On-site Consumption
Delaware	Delaware Medical Marijuana Act (2011)		Per jurisdiction	Alarm System, Security Plan		No Visible Cultivation
Maine	An Act to Amend the Maine Medical Marijuana Act (2010)	500 Ft	Per jurisdiction	“Appropriate Security Measures” to Prevent Unauthorized Entrance		
New Jersey	New Jersey Compassionate Use Medical Marijuana Act (2010)		Per jurisdiction	“Adequate Security”		
New Mexico	The Lynn and Erin Compassionate Use Act (2010)	300 ft		Alarm System, Security Plan		
Rhode Island	The Edward O. Hawkins and Thomas C. Slater Medical Marijuana Act (2009)	500 ft	Per jurisdiction	Alarm System, Security Measures to Prevent Unauthorized Entrance		No On-site Consumption
Vermont	An Act Relating to Registering Four Nonprofit Organizations to Dispense Marijuana for Symptom Relief (2011)	1,000 ft	Per jurisdiction	Alarm System, Security Plan to Prevent Unauthorized Entrance	By Appt Only	No On-site Consumption

Table 2: Medical Marijuana Dispensary Regulations by Local Jurisdictions

Policy for Local Jurisdiction	Zoning	Residential Buffers	School Buffers	MMD Buffers	Density Controls	Security Measures	Hours of Operation	Operations
La Paz County, AZ Ordinance No. 2011-02 (2011)	P Commercial*		500 ft	500 ft		Single Secured Entrance (SSE)	9AM-4PM	Sq Ft Limit, No Drive-Thru, No Seating, No Delivery
Phoenix, AZ Ordinance G-5573 (2010)	P Commercial**	1,000 ft	1,320 ft	5,280 ft				
Los Angeles, CA Ordinance No.181069 (2010)	None Specified	Not Adjacent	1,000 ft	1,000 ft	Per Population; Cap at Moratorium	Cameras, Alarm, SSE, Outdoor Lights, Signage, Safe for Storage	10AM-8PM	No On-site Consumption; No visible cultivation
Sacramento, CA Ordinance 2009-033 (2009); Ordinances 2010-037 & 2010-038 (2010)	P Commercial* SU Commercial*** SU Industrial****	300 ft	600 ft	1,000 ft	Cap at Moratorium	Cameras, Alarm, SSE, Security Guard, Outdoor Lights, Signage, Safe for Storage	7AM-9PM	No On-site Consumption; No visible cultivation; Sq Ft limit
Denver, CO Council Bill No. 34 (2010)	No Residential		1,000 ft	1,000 ft		Cameras, Alarm, SSE, Security Guard	7AM-9PM	
Washington, DC Legalization of Marijuana for Medical Treatment Amendment (2010)	No Residential		300 ft		5-8 for City	Alarm, Outdoor Lights, Signage, Safe for Storage	Limits Indicated	No On-site Consumption
Ann Arbor, MI Ordinance No. ORD-10-37 (2010)	P Downtown; P Local and Campus Business Districts; P Limited, Light, and Heavy Industrial Districts; P Planned Unit Development Districts		1,000 ft			Cameras, Alarms, Safe for Storage	7AM-9PM	No On-site Consumption; Sq Ft Limit; No Drive-Thru
Seattle, WA Ordinance No. 123661 (2011)	None Specified		1,000 ft					

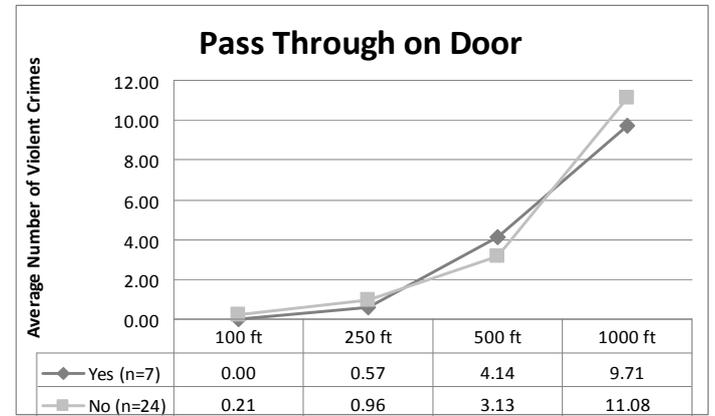
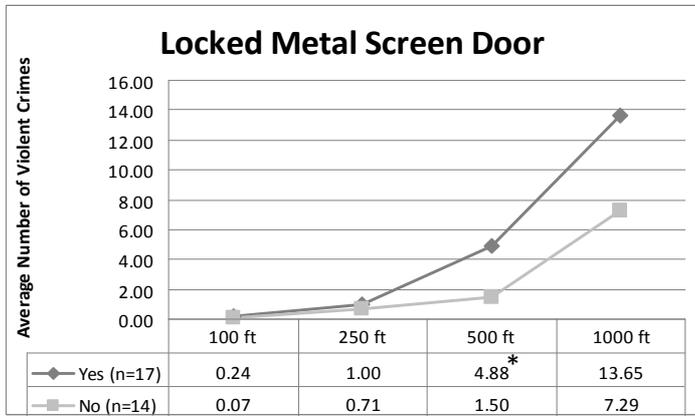
P = Permitted, SU =Special Use Permit, CU = Conditional Use Permit,

* C-2 "General Commercial," ** C-2 "Intermediate Commercial", *** C-4 "Heavy Commercial Zone", **** M-1, M-1(S), M-2, M-2(S) "Light" and "Heavy Industrial"

Table 3: Effectiveness of Policy Components

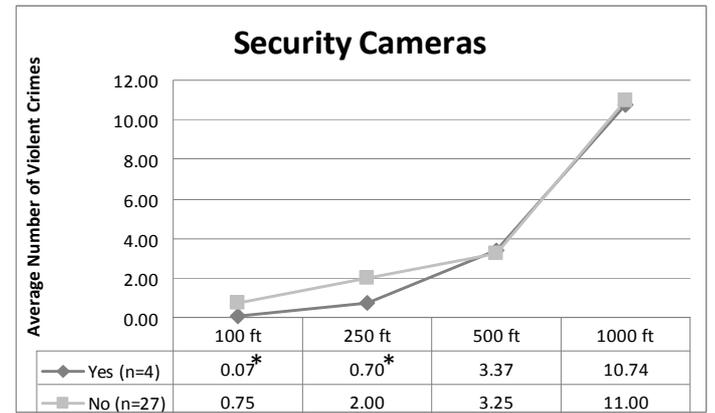
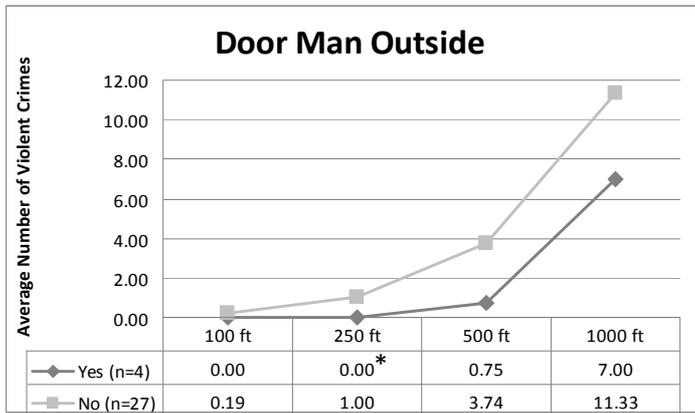
Policy Component	Example of Use in MMD Policies	Empirical Evidence of Implementation/Effectiveness
<i>Density Controls</i>	Limit number per population, per pharmacy, or introduce moratoriums	<ul style="list-style-type: none"> • No study of the effects of density controls for MMD on crime. • Alcohol outlet density and crime are positively related (Gorman, Speer, Gruenewald, & Labouvie, 2001; Gruenewald & Remer, 2006; Scribner, MacKinnon, & Dwyer, 1995). • New Jersey implemented policy to control density of alcohol outlets. On-premise outlets continued to be positively related to crime; off-premise outlets were not related to crime (Schwester, 2010).
<i>Zoning & Distance Buffers</i>		
Zoning Restrictions	No Residential; Commercial Districts Only	<ul style="list-style-type: none"> • No study on the effects of zoning restrictions for MMD on crime. • Zoning restrictions of business selling alcohol, pornography, and firearms used to protect residential populations from secondary effects, such as crime (Ashe, et al., 2003; Holder, et al., 2000; Papayanis, 2000). • A multi-component intervention that used zoning restrictions for alcohol outlets was associated with a decrease in high risk drinking and alcohol-related injuries (Holder, et al., 2000).
Distance Buffers	1,000 feet distance from school, child care facility, community center, park, or church	<ul style="list-style-type: none"> • No study on the effects of distance buffers for MMD on crime. • A multi-component intervention that used distance buffers for alcohol outlets was associated with a decrease in high risk drinking and alcohol-related injuries (Holder, et al., 2000).
<i>Crime Prevention Through Environmental Design (CPTED)</i>		
Security Measures	Individualized Security Plans Required; Alarm, Locked Doors, Security Guards	<ul style="list-style-type: none"> • No study on the effects of MMD security measures on crime. • Multiple component approaches were associated with higher reductions in robberies (Casteel & Peek-Asa, 2000). • Highest reductions for those sites that used individualized security plans (Casteel & Peek-Asa, 2000; Mair & Mair, 2003). • The odds of workplace homicide decreased with the presence of bright exterior lighting, security alarms, cash drop boxes, and the implementation of at least five environmental measures (e.g., barriers, video cameras) (Loomis, et al., 2002). • Single components found to be effective are: employing a second clerk, locked entrances, security hardware, and hiring guards (Casteel & Peek-Asa, 2000; Cozens, et al., 2005; Loomis, et al., 2002)
Hour of Operation	9AM-4PM, 10AM-8PM, 7AM-9PM	<ul style="list-style-type: none"> • Majority of crimes tend to occur between late afternoon to early morning hours (Felson & Poulsen, 2003).

Figure 1: Relationship of Dispensary Security Measures to Numbers of Violent Crimes within 100, 250, 500, and 1000 Feet Buffers



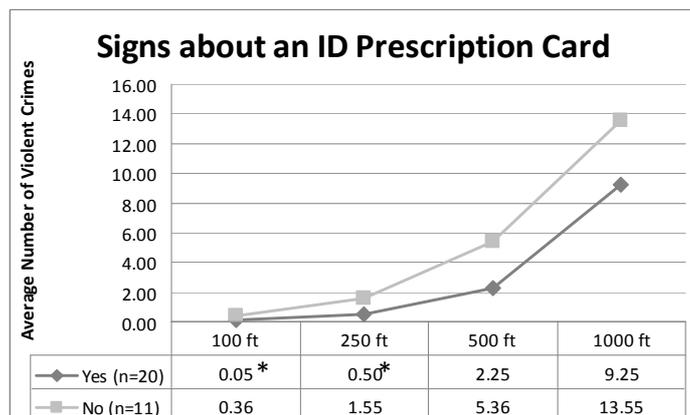
1a. Violent Crime and Locked Metal Screen Door

1b. Violent Crime and Pass Through on Door



1c. Violent Crime and Door Man Outside

1d. Violent Crime and Presence of Security Cameras



1e. Violent Crime and Signs about needing an ID Prescription Card

*p < .10