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Maricopa County Manager's Office Report:

medical marijuana use and diversion

ASU Center for **Violence Prevention and Community Safety**

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Arizona Arrestee Reporting Information Network

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Medical Marijuana Use and Diversion: Prevalence and Correlates from an At-Risk Sample

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Introduction

Over the past 17 years, 20 states and the District of Columbia have enacted legislation

that permits marijuana use for medical purposes.[1] A number of studies have found marijuana to

have some health benefits, such as pain relief, appetite stimulation, as well as promising

treatment effects for multiple sclerosis (MS), Tourette's syndrome, epilepsy, and glaucoma.[2]

While the legislation is intended to increase marijuana's accessibility to legally authorized

patients, there is substantial concern among residents, public health and criminal justice officials,

and policymakers that these laws might result in several unintended consequences such as the

increased availability and use of marijuana, the diversion of medical marijuana to others for non-

medical purposes, as well as a change in social norms that are more accepting of marijuana use.[3]

Despite these concerns, available research is limited and has produced mixed findings. As a

result, the extent to which these potential unintended consequences are rhetoric or reality remains

unknown.

For example, a growing body of research has examined the impact of medical marijuana

laws on general patterns of marijuana use. On the one hand, some researchers have reported that

marijuana use among adults and juveniles is higher in states that have enacted medical marijuana

legislation.[4] Alternatively, others have found no differentiation in marijuana use among high

risk populations (e.g., arrestees, emergency department patients, treatment facilities) between

states that have legislated medical marijuana use and those states that have not. One difference is

methodology: those that show increase are aggregate level and those that show no change are

individual level methods.[5] Similarly, researchers are increasingly studying the impact of

medicalization laws on the social norms related to marijuana use (a.k.a. wrong message

hypothesis). For example, anecdotal evidence has reported that such legislation will increase the

perceived benefits of medical marijuana use and potentially lead to increased abuse.[6] While these claims have been substantiated by some academic research,[7] other studies have reported that there is little relationship between the medicalization of marijuana and a change in attitudes and perceptions of using marijuana.[8] Last, an emerging body of research has begun to explore the diversion of medical marijuana to non-authorized individuals. The emergent findings of this nascent area of study suggest that diversion is a major issue among youth.[9] However, with few exceptions, researchers have failed to examine the implications of the medicalization of marijuana on the adult population.[10]

The current study seeks to explore these issues through an examination of the prevalence of medical marijuana use and diversion of medical marijuana among adults in an at-risk sample, with a specific focus on identifying the factors that are related to medical marijuana use and acquisition. We use data from a sample of recently booked adult arrestees, which allows for early identification of substantial shifts in drug use.[11] Recently booked arrestees represent a sample of the most "disadvantaged members of the urban underclass."[12] This sample serves as an effective source of data for identifying abrupt changes in patterns of drug use because it taps into those who are most likely to participate in the incubation phase of changing drug markets that later effect a larger population.[13] Therefore, our sample allows us to observe issues related to medical marijuana use in the early stages in the implementation of a new marijuana market. We first examine the prevalence of marijuana use over a 74-month period (6.2 years), before and after medical marijuana legislation was enacted. Next, we examine the socio-demographic and criminogenic characteristics of non-users, authorized medical marijuana users, non-authorized medical marijuana users and non-medical marijuana users. We then examine the relationship between marijuana use, criminality, drug acquisition, and drug use.

Methodology

Setting

The present study is set in Maricopa County, Arizona. Maricopa County is a fairly prosperous county with a slightly higher than average level of unemployment (8.3%) and a relatively similar median household income ($48,711) compared to the rest of the nation. The county underwent a substantial amount of growth between 1990 and 2010, increasing from 3,072,149 residents in 1990 to 3,817,117 in 2010; an increase of 24.2 percent. The current racial/ethnic composition of the county is diverse, with Caucasians making up approximately 75.9 percent of the community, African Americans, 6 percent; Asians, 4.4 percent, American Indians, 2.8 percent, and 14.5 percent, other race. Hispanics represent about 29.6 percent of the county's population.

In November 2010, Arizona voters passed The Arizona Medical Marijuana Act (AMMA) and the program went into effect on April 14, 2011. The legislation requires that patients must be recommended by a physician who verifies that the patient meets one of 13 qualifying conditions, which include: AIDS, ALS, Alzheimer's, cancer, Cachexia, chronic pain, Crohn's, Glaucoma, Hepatitis C, HIV, muscle spasms, nausea, and seizures (Arizona Department of Health Services, 2012). As of November 2012, the Arizona Department of Health Services had approved 18,001 applications for medical marijuana use in Maricopa County. The AMMA allows qualified patients to possess up to 2.5 ounces of marijuana, and to cultivate up to 12 marijuana plants if a registered medical marijuana dispensary is not operating within twenty-five (25) miles of the patient's home (http://www.azdhs.gov/medicalmarijuana/cultivation-boundary). Of the approved cardholders 14,760 were simultaneously approved to cultivate marijuana (81.9%). In December 2012, the first dispensary opened in the county and today there are 15 medical marijuana dispensaries throughout the area. Some anecdotal evidence suggests that the

rapid expansion of dispensaries and medical marijuana use might have impacted illicit drug markets. Mexican government officials, for example, have argued that the amount of marijuana crossing the U.S.-Mexican border will only increase due to the higher demand of marijuana through its medicalization.[14] In fact some empirical evidence suggests that marijuana use might have increased in the county. For example, a bi-annual survey of 8th, 10th, and 12th grade Maricopa County students showed that 30-day marijuana use among students has increased from 11.9 percent in 2008 to 14.3 percent in 2012.[15] However, little information is available regarding prevalence and use patterns among adults

Study Design

The present study examines data from the Arizona Arrestee Reporting Information Network (AARIN), which was originally established in 1987 under the auspices of the Drug Use Forecasting (DUF) program, and later the Arrestee Drug Abuse Monitoring Program (ADAM), both sponsored by the National Institute of Justice (NIJ) to monitor drug use trends, treatment needs, and at-risk behavior among recently booked arrestees. The program collected data from recently booked arrestees in 35 sites across the United States. In 2007, after NIJ terminated the nationwide program due to funding constraints, a few jurisdictions continued to fund the program through the use of local funds. Maricopa County was one of those sites. The AARIN program maintained the same methodology as the ADAM project so that trends among recently booked arrestees could continue to be monitored over time. While the AARIN project samples males and females from both the adult and juvenile populations, the data used in the present study are restricted to adult arrestees.

In order to ensure representative results for the entire population of arrestees in Maricopa County, the AARIN project employs a systematic sampling protocol that includes the collection of data at the County's central intake facility, which is the fourth largest jail in the United States. Data are collected during a two-week period each quarter. Arrestees who were cited on the street and released, or released for other reasons, were not included in the study. During data collection periods, for 8 hours each day, interviews are conducted with arrestees who are randomly selected based on booking time. Consistent with the ADAM sampling strategy, a "stock" (i.e., arrested during non-data collection hours) and "flow" (i.e., arrested during data collection hours) selection process is employed to ensure a representative sample of arrestees.[16] Arrestees who were in custody longer than 48 hours are ineligible for participation in AARIN. As an incentive, respondents are provided with a candy bar if they complete the survey.

Instrument and Measures

A structured survey instrument is used to generate self-report data on a variety of socio-demographic and behavioral variables. Before beginning the interview, respondents were read an informed consent script in which verbal consent was required before data collection began. Respondents reported their age, race/ethnicity, and educational background and then answered a series of questions about their participation in various activities including drug use, drug acquisition and drug market conditions. Additionally, respondents were asked about medical marijuana use, whether they have a medical marijuana card, as well as the chronic illnesses they have been diagnosed with that qualified them for medical marijuana.[17] At the end of the interview each respondent was asked to provide a urine sample. The urine sample is analyzed for four different drugs: marijuana, cocaine, opiates, and methamphetamines. The urinalysis (UA) is

calibrated to detect drugs ingested within 72 hours of the interview and to keep false positives to no more than 2 per 100.[18]

Three items were used to construct the primary outcome variable for the present study: "In the past 30 days, how many days did you use marijuana?" "Do you have a medical marijuana card for the State of Arizona," and "Have you used medical marijuana in the State of Arizona [in the past 30 days]." Respondents were categorized into four groups, displayed in Exhibit 1. Respondents who self-reported not having a medical marijuana card and had not used marijuana in the past 30 days were categorized as "non-users." Respondents who reported using medical marijuana in the past 30 days and had a medical marijuana card issued by the State of Arizona were categorized as "authorized medical marijuana users." Those who reported not having a medical marijuana card, reported not using medical marijuana, but who self-reported marijuana use were coded as "non-medical marijuana users." Those respondents who reported not having a medical marijuana card but reported using medical marijuana were coded as "non-authorized medical marijuana users."[19]

Exhibit 1: Categories of Medical Marijuana Users

	Non-user	Authorized medical marijuana user	Non-medical marijuana user	Non-authorized medical marijuana user
Marijuana use past 30 days	No	--	Yes	--
Medical marijuana card	No	Yes	No	No
Medical marijuana use past 30 days	No	Yes	No	Yes

In addition to describing the prevalence of medical marijuana (MMJ) use, we also examined several variables that might be linked to medical and non-medical marijuana use. These variables include socio-demographic characteristics such as ethnicity, sex, age, education, employment and medical insurance coverage. We also include items related to current and prior criminal involvement and current and prior drug use to examine their relationship with medical

marijuana use. Finally, we examine the relationship between marijuana use and several items related to the marijuana market and the acquisition of marijuana.

Sample

Interviews were conducted within 48 hours of the participant being booked, between October 2011 and June 2013. Of the 3,094 eligible recently booked arrestees, 87.3 percent (n=2,702) agreed to participate in the study and completed the interview, and of these participants, 97.6 percent provided a urine specimen (n= 2,638). Exhibit 2 provides descriptive information about our sample. The sample was predominantly male (76%) and comprised of white (38.1%) and Hispanic (32.6%) participants. The mean age of respondents was 32.33 years old, and most reported either completing a high school education (34.3%) or participating in a post high school education experience (34%) (e.g., undergraduate, masters, professional degree). Approximately 13 percent of participants reported currently living with a spouse (n=349) and 41.6 percent (n=1,126) reported having medical insurance.

Exhibit 2. Sample demographics and background characteristics (N=2,702)

	n	Percent
Sex		
Male	2054	76.0
Female	648	24.0
Race		
White	1028	38.1
Black	331	12.3
Hispanic	879	32.6
Other	462	17.1
Mean age (SD)	2701	32.33 (10.604)

Exhibit 2 continued. Sample demographics and background characteristics (N=2,702)

	n	Percent
Education		
No high school	848	31.6
High school	920	34.3
Post high school	912	34.0
Medical insurance	1126	41.6
Spouse	349	12.9
Employment		
No employment	1268	48.6
Part- or full-time	1339	51.4
Mean income from legal sources (SD)	2627	$1217.26 (1567.85)
Mean income from illegal sources (SD)	2647	$396.37 (1471.34)
Current charge		
Violent	515	19.1
Property	595	22.1
Drug-Related	746	27.7
Other	842	31.2
12 month self-reported criminal involvement		
Violent	854	31.6
Mean number of times (SD)	2702	9.75 (51.894)
Property	572	21.2
Mean number of times (SD)	2702	5.86 (36.652)
Drug use	2450	90.7
Mean number of times (SD)	2702	14.11 (12.23)
Drug sales	318	11.8
Mean number of times (SD)	2698	15.40 (65.905)
30-day marijuana use	1172	43.4
30-day medical marijuana use (acquired in Arizona)	350	13.0
Possess a medical marijuana card	69	2.6
Medical marijuana use		
No use, no card	1504	56.1
Authorized medical marijuana user	60	2.2
Non-medical marijuana user	828	30.9
Non-authorized medical marijuana user	290	10.8

With respect to the participants' current charge for which they were arrested, nearly a fifth (19.1%, n=515) were arrested for a violent offense, including assault, murder, robbery, and kidnapping. Close to 28 percent (n=746) were arrested for a drug related offense (e.g., drug trafficking, possession), 22.1 percent (n=595) were arrested for a property crime, and 31.2 percent (n=842) were arrested for some other offense. Related, 31.6 percent of participants self-reported engaging in a violent crime over the previous 12 months (n=854), 21.2 percent self-reported engaging in property crime (n=572), 90.7 percent self-reported using drugs in the previous 12 months (n=2,450), and 11.8 percent reported selling drugs (n=318).

Among the sample, 2.6 percent (n=69) self-reported having a medical marijuana card that was issued by the State of Arizona. We asked participants about the illnesses related to their acquisition of a medical marijuana card. The majority of participants (71.0%) self-reported obtaining a medical marijuana card because of "severe and chronic pain." Just over seven percent reported obtaining their medical marijuana card because of chronic muscle spasms, and 4.3 percent reported it was for cancer. Participants also reported several other conditions: 2.9 percent for HIV/AIDS, 1.4 percent for glaucoma, 2.9 percent for severe nausea and none of the respondents reported they obtained their card for reasons related to Alzheimer's, Chron's disease, amyotrophic lateral sclerosis, cachexia, seizures or epilepsy, or multiple sclerosis.

Just over 56 percent of our sample was categorized as non-users; meaning that they self-reported not having a medical marijuana card and had not used marijuana in the past 30 days. About 31 percent of our sample was categorized as a non-medical marijuana user because they did not self-report having a medical marijuana card, reported not using medical marijuana, but self-reported marijuana use. Approximately two percent (2.2%) were classified as authorized medical marijuana users (i.e., had a card and had used medical marijuana). Last, 10.8 percent of

our sample were categorized as non-authorized medical marijuana users because they self-reported not having a medical marijuana card but reported using medical marijuana.
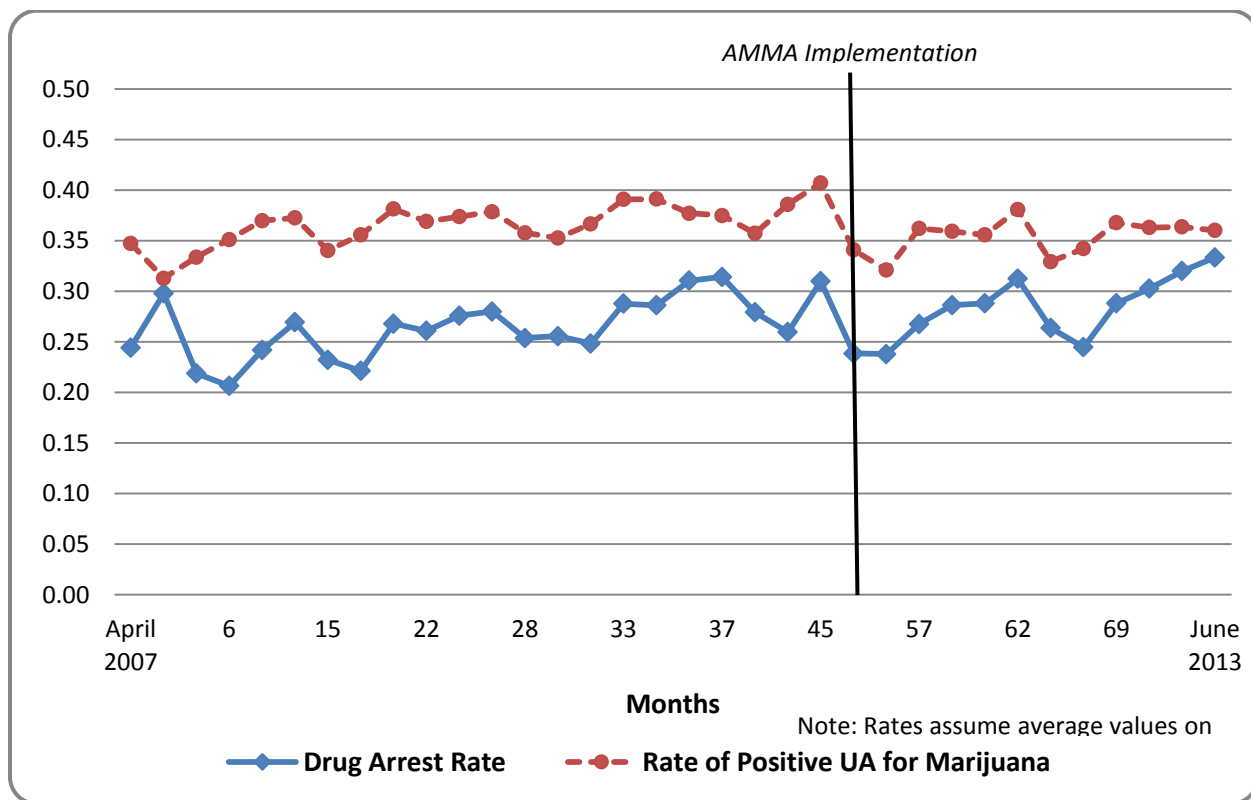
Results

Examining the Impact of the AMMA on Marijuana Use over Time

Exhibit 3 shows the results of urinalysis tests for marijuana from April 2007 and May 2013. The results show that marijuana use among recently booked arrestees in Maricopa County has fluctuated over the study period. For example, in April 2007 about 35 percent of respondents tested positive for marijuana. Marijuana use, in general, then increased until the first quarter of 2011 when 44.1 percent of respondents tested positive for marijuana. Following the first quarter of 2011 marijuana use declined through June 2013, when only 38.1 percent of respondents tested positive for marijuana.

In order to estimate the impact of AMMA on the prevalence of marijuana use we employed a technique similar to regression discontinuity.[20] In this design, respondents are assigned a linear calendar month based on the date of their AARIN interview, starting in April 2007 (month 0) to May of 2013 (month 74). We then coded a dichotomous variable equal to 0 if the month preceded the AMMA (months 0-52) and equal to 1 afterwards (months 53–74). We then fit a logistic regression predicting the log odds of the respondent testing positive for marijuana as a function of the linear month variable and the AMMA indicator. In regression discontinuity parlance, the month is the assignment variable and the AMMA indicator is the treatment indicator.[21] Since each data collection relied on different group of individuals,[22] we also controlled for several covariates including the quarter of the year, positive urinalysis test results for cocaine, opiates or methamphetamine, type of offense, gender, ethnicity, and whether they had been in jail or prison.

In terms of the effect on the rate itself, we estimate that at the onset of the implementation of AMMA (month 53), marijuana use declined by 4.8 percent (p = 0.023).[23] Exhibit 3 shows the predicted rate by month holding at average all predictors except yearly quarter and AMMA. In order to explore how long this effect lasted, we sequentially removed AMMA months and tested the effect. We were not able to reject the null hypothesis until we removed a year of data. That is, the effect was statistically significant for about a year following the implementation of AMMA, at which time marijuana use patterns resumed to their previous level.[24]

Exhibit 3: Predicted rates of positive marijuana urinalysis by month: April 2007 thru June 2013

Examining Characteristics of Medical Marijuana User Groups

Exhibit 4 reveals a number socio-demographic and criminal involvement differences between participants according to their use patterns. Authorized medical marijuana users were significantly more likely to be male (93.3%) and to report post-high school education (e.g., college). Non-users (34.85) were significantly older than authorized medical marijuana users (30.35), non-medical marijuana users (29.49), and non-authorized medical marijuana users (27.74). There were no significant differences in patterns of use by ethnicity.

Authorized medical marijuana users were also significantly more likely than other groups to report having medical insurance (61.7%) and being married (20%). Likewise, authorized medical marijuana users were significantly more likely to be employed (55.9%) than non-medical marijuana users (44.4%) and non-authorized medical marijuana users (49.3%). Authorized users reported the highest mean monthly legal income ($2033.69), from $700-1,000 more per month than the other user groups. Interestingly, authorized users also reported, by far, the highest mean monthly income from illegal sources ($1,328.29; compared to $948.02 for unauthorized medical marijuana users, $445.23 for non-medical marijuana users, and $231.74 for non-users).

Exhibit 4. Sample characteristics and criminal involvement by medical marijuana card possession (N=2702)

	n	Non-user (n=1504)	n	Authorized medical marijuana user (n=60)	n	Non-medical marijuana user (n=828)	n	Non-authorized medical marijuana user (n=290)
Sex*								
Male	1100	73.1	56	93.3	639	77.2	244	84.1
Female	404	26.9	4	6.7	189	22.8	46	15.9
Ethnicity								
White	564	37.5	26	43.3	312	37.7	117	40.3
Black	163	10.8	11	18.3	119	14.4	35	12.1
Hispanic	524	34.9	14	23.3	250	30.2	87	30.0
Other	252	16.8	9	15.0	146	17.7	51	17.6
Education*								
No high school	448	30.1	7	11.7	290	35.3	96	33.3
High school	499	33.5	13	21.7	304	37.0	101	35.1
Post high school	543	36.4	40	66.7	228	27.7	91	31.6
Medical insurance*	633	42.1	37	61.7	313	37.8	129	44.6
Spouse*	239	15.9	12	20.0	64	7.7	30	10.3
Employment*								
No employment	649	44.5	26	44.1	444	55.6	139	50.7
Part- or full-time	808	55.5	33	55.9	354	44.4	135	49.3
Mean income from legal sources (SD)*	1453	$1328.29 (1620.04)	59	$2033.69 (1855.85)	813	$968.26 (1370.99)	283	$1193.98 (1641.01)
Mean income from illegal sources (SD)*	1473	$231.74 (1186.68)	59	$1344.75 (2941.29)	815	$445.23 (1466.62)	280	$948.02 (2090.66)
Mean Age (SD)*	1503	34.85 (10.934)	60	30.35 (9.100)	828	29.49 (9.341)	290	27.74 (8.858)
12 month self-reported criminal involvement								
Violent*	365	24.3	28	46.7	303	36.6	152	52.6
Mean number of times (SD)*	1504	5.84 (39.777)	60	21.38 (76.110)	828	9.65 (50.171)	290	28.55 (89.922)
Property*	228	15.2	15	25.0	225	27.2	102	35.3
Mean number of times (SD)*	1504	3.85 (30.953)	60	5.48 (26.841)	828	7.10 (40.159)	290	13.16 (52.239)
Drug Sales*	96	6.4	18	30.0	132	16.0	70	24.2
Mean number of times (SD)*	1503	8.10 (48.496)	60	41.82 (104.171)	827	18.41 (70.485)	288	40.38 (104.33)

* $p < .05$

Note: six respondents reported recreational marijuana use but did not report illegal or medical marijuana use. Consequently, recreational use was not reported for these respondents.

Related, 30% of authorized medical marijuana users self-reported dealing drugs in the past 12-months, compared to 24.2% of non-authorized medical marijuana users, 16% of non-medical marijuana users, and 6.4% of non-users. Likewise, authorized medical marijuana users self-reported a higher rate of drug sales (41.82) than unauthorized marijuana medical users (40.38), non-medical marijuana users (18.41), and non-users (8.1). The higher rates of drug selling among authorized medical marijuana users is likely tied to their elevated monthly income from illegal sources. Non-authorized medical marijuana users, on the other hand, were significantly more likely to self-report involvement in violent (52.6%) and property crime (35.3%).

Exhibit 5 presents findings related to patterns of drug use by type of marijuana user. There were no significant differences between groups regarding their use of crack or powder cocaine. However, non-users (18.7%) and authorized medical marijuana users (13.3%) were significantly less likely to report having used methamphetamines in the past 30 days, compared to non-medical marijuana users (37.3%) and non-authorized medical marijuana users (36.9%). Non-authorized medical marijuana users were also the most likely to self-report heroin or other opiate use (14.5%), followed by authorized medical marijuana uses (11.7%), non-medical marijuana users (11.1%), and non-users (6.3%).

Exhibit 5. Drug use by medical marijuana card possession (N=2,702)

	n	Non-user (n=1504)	n	Authorized medical marijuana user (n=60)	n	Non-medical marijuana user (n=828)	n	Non-authorized medical marijuana user (n=290)
Percent self-Reported 30-Day Use								
Crack cocaine	58	3.9	1	1.7	38	4.6	13	4.5
Powder cocaine	50	3.3	6	10.0	81	9.8	51	17.6
Methamphetamine*	281	18.7	8	13.3	309	37.3	107	36.9
Heroin or other opiate*	94	6.3	7	11.7	92	11.1	42	14.5
Mean Number of Days Used in Past 30-Days (SD)								
Marijuana*	n/a	n/a	60	21.55 (11.990)	828	12.91 (11.692)	290	18.67 (11.646)
Crack cocaine*	1504	0.42 (3.00)	60	0.03 (.258)	828	0.39 (2.825)	290	0.35 (2.109)
Powder cocaine*	1504	0.16 (1.473)	60	0.95 (4.760)	828	0.32 (1.653)	290	0.99 (3.922)
Methamphetamine*	1504	2.47 (7.148)	60	2.07 (6.837)	828	5.19 (9.478)	290	5.91 (10.488)
Heroin or Other Opiate*	1503	1.26 (5.671)	60	2.38 (7.881)	828	2.01 (6.948)	290	2.59 (7.623)
Positive Urine Test								
Marijuana*	66	4.7	48	85.7	561	71.6	219	79.1
Cocaine	106	7.6	2	3.6	70	8.9	28	10.1
Methamphetamine*	371	26.6	13	23.2	322	41.1	99	35.7
Heroin or other Opiate*	135	9.7	10	17.9	102	13.0	48	17.3

* p < .05

Our findings with respect to the urinalysis data were fairly similar to those obtained through the self-report data. For example, marijuana rates were high for all groups (from 71-86%), and there were no group differences with regard to cocaine use. Methamphetamine rates were highest for non-medical marijuana users and non-authorized medical marijuana users. There is one notable exception, however. Unlike the self-report findings, the urinalysis results indicate that authorized medical marijuana users had the highest rates of heroin or opiate use (17.9%).

Last, we examined correlates of market and acquisition patterns by type of user. Exhibit 6 shows that authorized medical marijuana users (91.5%) and non-authorized medical marijuana users (91.4%) were the most likely to report obtaining marijuana in the past 30 days, followed by non-medical marijuana users (76.4%), and non-users (3.4%). Similarly, authorized medical marijuana users (13.43 days) and non-authorized medical marijuana users (12.83 days) reported obtaining marijuana more frequently in the past 30 days. Authorized medical marijuana users self-reported spending about $492 in the past 30 days on marijuana, compared to about $268 for non-authorized medical marijuana users, about $224 for non-users, and about $101 for non-medical marijuana users. Interestingly, the non-users reported acquiring about 2,420 grams of marijuana in the past 30 days, compared to 810 grams of marijuana for authorized medical marijuana users, 428 grams of marijuana for non-medical marijuana users, and 349 grams for non-authorized medical marijuana users (this large amount is explained by several respondents who were outliers). About 35 percent of authorized medical marijuana users self-reported selling marijuana, a rate that is substantially higher than the other groups. Acquisition methods varied significantly across groups. Authorized medical marijuana users, non-authorized medical marijuana users, and non-medical marijuana users all reported that more than half the time they

purchased their marijuana. While the other user groups rarely reporting growing their marijuana, authorized medical marijuana users reported that about 15 percent of the marijuana they acquire is "home-grown." With regard to source, authorized medical marijuana users self-reported that about 40 percent of their marijuana is from a legal dispensary, compared to about 1 percent or less for other types of users. Likewise, about 15 percent of authorized medical marijuana users marijuana is obtain by growing their own compared to about 3 percent for non-users, and less than 1 percent for unauthorized medical marijuana users and non-users. The other user groups were much more likely to report obtaining marijuana from a friend.

Exhibit 6. Marijuana market and acquisition by medical marijuana card possession (N=2702)

	n	Non-user (n=1504)	n	Authorized medical marijuana user (n=60)	n	Non-medical marijuana user (n=828)	n	Non-authorized medical marijuana user (n=290)
Obtained any marijuana in the past 30 days*	51	3.4	54	91.5	633	76.4	265	91.4
Average number of days any marijuana was obtained (SD)*	51	3.69 (6.038)	54	13.43 (11.882)	631	9.25 (10.078)	265	12.83 (11.069)
Average amount spent on any marijuana (SD)*	49	$223.61 (1,017.57)	53	$491.89 (1,105.86)	626	$101.49 (492.83)	260	$267.57 (858.42)
Average quantity of any marijuana acquired in grams (SD)*	48	2419.57 (13,146.08)	54	809.99 (1,885.31)	610	428.49 (2,522.81)	260	349.09 (1,692.10)
Sold any marijuana*	10	1.2	20	34.5	79	10.8	65	23.4
Acquisition of Marijuana Method - Mean (SD)								
% bought*	51	40.86 (47.301)	54	66.85 (43.299)	625	52.69 (45.668)	264	59.94 (41.757)
% grown*	51	3.73 (16.366)	54	14.54 (33.453)	625	0.68 (7.714)	264	1.16 (7.950)
% traded	51	1.96 (14.003)	54	3.33 (15.141)	625	2.01 (11.857)	264	4.05 (15.467)
% free*	51	53.43 (49.097)	54	13.06 (31.314)	625	42.86 (45.495)	264	33.47 (40.719)
% other	51	0.02 (.140)	54	1.85 (13.608)	624	2.13 (14.225)	264	1.38 (10.266)
Source - Mean (SD)								
% legal dispensary in Arizona*	51	0.00 (.000)	53	32.45 (43.508)	615	0.54 (7.095)	260	1.15 (9.516)
% legal dispensary in another state*	51	0.00 (.000)	53	8.11 (26.096)	615	0.57 (7.027)	260	0.83 (8.776)
% friend*	51	64.90 (47.175)	53	23.30 (39.173)	616	53.60 (48.624)	260	50.44 (48.222)
% through a friend	51	18.63 (38.679)	53	8.21 (24.280)	615	23.40 (41.339)	260	22.23 (40.363)
% dealer	51	11.76 (32.540)	53	7.55 (26.668)	615	15.63 (35.641)	260	19.29 (37.297)
% grew their own*	51	2.75 (14.977)	53	14.72 (33.733)	615	0.77 (8.519)	260	0.94 (7.747)
% other	51	1.96 (14.003)	53	5.66 (23.330)	615	5.55 (22.566)	260	4.73 (20.579)

* p < .05

Discussion

Over the past several years, policymakers and researchers have discussed the potential impact of the medicalization of marijuana on patterns of use. Some have maintained that the implementation of medical marijuana laws will result in unintended consequences such as increased availability of marijuana through its diversion from authorized patients to unauthorized users, or use will increase demand through changes in social norms about marijuana use. The findings from the present study, however, suggest that the implementation of the AMMA was associated with a temporary decrease (5%) in marijuana use among our at-risk sample.

We explored one plausible explanation in which there might have been a shift in law enforcement behavior immediately following implementation. After we controlled for the type of offense for which the respondent was arrested the results indicated that for a brief period of time police arrested fewer people for drug related offenses; individuals who in the past have been found to be significantly more likely to test positive for marijuana.[25] Therefore, we believe that one explanation for the temporary drop in the proportion of respondents testing positive for marijuana is that the police changed their behavior for a short period of time and arrested fewer people for drug related offenses, which led to fewer persons who use marijuana being arrested and included in our sample. However, we also believe that it is plausible that the announcement and implementation of the law resulted in a temporary "shock" to the marijuana market that impacted use and/or distribution. The causal mechanisms for how such a change might disrupt the market, however, is unclear. It might be that following AMMA implementation some users and/or buyers lost confidence in the market, which reduced demand and/or supply. Over time, the market began to stabilize and slowly return to normal. Anecdotal evidence suggests that both of these issues were at play during this period of time.

The study results also suggest that authorized medical marijuana use among our high-risk sample is similar (about 2%) to initial findings derived through (self-report) samples from the general population. Prior research has shown that, among at-risk samples such as emergency room admissions and recently booked arrestees, prescribed medication use is higher than the general population, often because of higher rates of mental and physical illness[26]. Additionally, we might expect that among a high-risk sample of arrestees, a group that self-reports substantially higher rates of criminality in general and marijuana use and sales specifically, authorized medical marijuana use would be higher than the general population because of their higher level of recreational use. In fact, a large number of law enforcement associations have voiced substantial concern about the medicalization of marijuana fearing that criminals, addicts, and others will frequently falsify symptoms and documents to obtain medical grade marijuana for use and sales.[27] Our findings suggest, however, that those in the offender population are no more likely to obtain marijuana legally than the general population.

With the above said, authorized medical marijuana users displayed a number of characteristics that were unique and distinguished them from unauthorized medical marijuana users, non-medical marijuana users, and non-users. On the one hand, these individuals tended to more frequently be male, better educated, employed, and have healthcare insurance. They were also found to report significantly higher rates of acquisition, consumption, and expenditures for marijuana. These individuals reported the highest rate of acquisition of marijuana through dispensaries and self-cultivation concomitant with the lowest rates of marijuana acquisition from dealers and/or friends. In this respect, our findings are consistent with prior research.[28]

On the other hand, authorized medical marijuana users more frequently reported selling marijuana, being involved in violent crime, and having a history of drug related charges. Their

urinalysis results also indicated higher rates opiate use. While greater involvement in drug sales might be a result of access to medical marijuana, assuming that those with access to use medical marijuana may have, by extension, an increased opportunity to sell marijuana, their disproportionate involvement in violent crime suggests that a deeper involvement in a criminal lifestyle than suggested by prior research (only non-authorized medical marijuana users had a higher rate of involvement in violent crime). This issue is discussed further below. Their high use of marijuana and opiates (and low use of cocaine and methamphetamines), coupled with higher rates of prior drug arrests, however, might also suggest that these individuals have been self-medicating health problems prior to the implementation of AMMA. Prior research has found that those suffering from chronic illnesses are more likely to use opiates to reduce pain,[29] and it is possible that these same individuals used illicit marijuana to relieve their pain. In fact, 71 percent of authorized medical marijuana users self-reported that they were prescribed medical marijuana for severe pain. This would necessarily result in a higher risk of arrest for drug offenses prior to AMMA; and following AMMA, their inclination to use marijuana to relieve pain might result in their seeking authorization to legally use marijuana. It could, however, also suggest that for some individuals the motivation behind the acquisition of a medical marijuana card is to reduce their risk of future involvement in the criminal justice system. Acquiring legal authorization to use marijuana would reduce their legal risks associated with frequent marijuana use, an issue that in the past led to their arrest. While our findings provide some initial insight on these issues, future research is needed to understand motivations related to authorized medical marijuana acquisition and use.

We also found that medical marijuana diversion is prevalent and is likely higher than for other types of medication. While this body of research is still in its infancy, prior research

suggests that, for adults in the general population, the non-medical to medical use ratio is .61 for sleep medication, .85 for anxiety medication, .38 for pain medication, and 2.45 for stimulant medication for ADHD.[30] Similar trends have been observed in samples of at-risk individuals examining the ratio of non-medical to medical opioid use.[31] However, the present study suggests that for every one authorized medical marijuana user about five unauthorized persons use medical marijuana (ratio of 4.9 to 1). Further, about 25 percent of all marijuana users reported non-authorized use of medical marijuana. These findings suggest that although the implementation on AMMA is relatively new, diversion of medical marijuana to non-authorized users has already begun and is more prevalent than other types of medication.

These findings have important policy implications for the prevention of unauthorized medical marijuana diversion. First, and most notably, these data provide preliminary evidence of the integrity of the AMMA legislation. With rare exception, only those reporting possession of a medical marijuana card reported acquisition through a dispensary, operating either in Arizona or in another state. These same individuals also displayed the highest reported rates of self-cultivation, concomitant with the lowest rates of dealer or friend acquisition. For these users of marijuana, their acquisition patterns through black-market and illicit networks appear to have been disrupted and replaced by a growing reliance upon legal acquisition means of dispensaries and self-cultivation.

Second, our analysis indicated that almost three quarters of authorized medical marijuana users self-reported that they were proscribed medical marijuana for severe pain. This suggests that there may be issues related to falsifying documentation as has been found in past research on opiates. The medical profession has long tried to differentiate patients with chronic nonmalignant pain from those who are seeking misuse or are addicted to opiates by observing

certain patient behaviors. Over the last several years a number of attempts have been made to develop clinician-based instruments that can be used to determine whether a patient is using opiates inappropriately.[32] Given the rapid spread of the medicalization of marijuana clinicians should begin to discuss the development of an assessment instrument that helps practitioners reliably diagnose those who are reporting false symptoms in order to misuse medical marijuana.

Third, and related, we found that more than one-third of authorized medical marijuana users sell marijuana. This suggests that a major source of diversion may be the result of authorized users selling their marijuana to non-authorized users. In fact, our analysis showed that authorized medical marijuana users on average earned $1,345 a month from illicit sources, which is 1.4 times as much as unauthorized medical marijuana users ($948), three times as much as non-medical marijuana users ($445), and almost six times as much as non-users ($232). While more detailed data collection would be necessary to further understand this source of diversion, it is consistent with prior research on the diversion of pain medication (i.e., where individuals obtain medication legally, and sell it to their friends and others for additional income).[33]

These results, coupled with our finding that more than 70 percent of unauthorized medical marijuana users acquire their marijuana through friends or friendship networks, further confirms public health and law enforcement officials' speculation that "sponsored" medical marijuana diversion is occurring through authorized users. By its very nature this type of diversion is in some ways very difficult to contain. Prior research on exchange networks has revealed that following repeated successful transactions trust among individuals increases, particularly when the transactions involve risk.[34] Our findings suggest that most non-authorized medical marijuana users obtain it from individuals whom they already trust. Traditional law enforcement strategies are largely insufficient for addressing these types of issues and a

regulatory approach similar to that of pharmacy monitoring systems might be an appropriate strategy for further understanding the scope and nature of this problem and determining appropriate responses.

Study Limitations

Several potential limitations should be noted and serve as context for interpretation of the results. First, the findings should not necessarily be generalized to other communities. A number of prior studies have shown that community drug problems are often unique and might vary from one community to the next.[35] Second, the present study relied on a cross-sectional research design using measures that have been found to be related to drug use; however, the results should not be interpreted as implying causality. Third, the present study largely relied on self-report data to determine medical and non-medical marijuana use, and the human subjects protections protocol developed for the project did not permit us to obtain official data on participant's acquisition of a medical marijuana card. While prior research has determined that self-reported behavior is a robust method of measuring various concepts related to prescription medications[36] and illegal substances,[37] we are unaware of any research examining the validity of self-reported medical marijuana use. Last, the present study relied on a sample of recently booked adult arrestees. Our findings should not be generalized to the larger population because little is known about medical marijuana use and diversion among non-criminal justice involved persons.

Conclusions

We found that after controlling for arrest charge, the proportion of our sample which tested positive for marijuana did not significantly change over the course of the study period. In other words, introduction of the AMMA did not affect marijuana use rates among this at-risk population. Additionally, we found that a small proportion of our sample acquired a medical

marijuana card. These individuals possessed greater social capital than other types of users but were also more likely to be involved in violent crime and drug sales. These individuals may also be serving as a substantial source for others to acquire medical marijuana. For every authorized medical marijuana user, another five non-authorized persons used medical marijuana.   In the future researchers should further examine medical marijuana diversion and the extent to which different types of diversion take place.[38] Prior research has shown that there are several mechanisms for diverting other forms of medication (e.g., pain medication) for unauthorized purposes. [39]Our findings suggest that much more work is needed to understand the mechanisms associated with the diversion of medical marijuana.

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[17] Much prior research has examined the reliability and validity of self-reported data obtained from recently booked arrestees by examining the correspondence between self-reported drug use and urinalysis. This body of work has shown that data collected from recently booked arrestees in general, and recently booked arrestees who participated in the DUF, ADAM, and AARIN programs specifically are reliable and valid (Katz et al., 1997; Webb et al., 2006; White, 2009, 2010).

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[21] In order to validate our findings, we ran several simulations on hypothetical data, simulating the temporal trend and average rate of substance use. We found that this estimator is consistent in estimating the correct effect on the log-odds of substance use. Other methods would be to employ a count model on data where each month is an observation, with a variable for incidents and another variable for exposure. We found that this produced the same results. In this study, however, we choose to use the logistic model as it allowed for individual level controls.

[22] While it is possible that an individual arrested and interviewed during one period, is arrested and interviewed in another period it is very rare.

[23] Our model produced a time trend of 0.003 (p = 0.079) log-odds increase by month and an AMMA coefficient of -0.206 log-odds (p = 0.022), equivalent to an odds ratio of 0.81, or a 19 percent reduction in the log-odds of testing positive.

[24] To contextualize our results that AMMA led to a temporary decrease in marijuana use, we also ran a longitudinal multinomial logistic regression predicting the offense for which the respondent was arrested (i.e., violence, property, drug related or other). The model included the same set of covariates to standardize the predictions. We then plotted the standardized predictions of the rate of respondents who were arrested for a drug-related offense with the plot of respondents who tested positive for marijuana. We found that the pattern of positive urinalyses tests for marijuana was also reflected in the rates for respondents being arrested for a drug offense.

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About the Center for Violence Prevention & Community Safety

Arizona State University, in order to deepen its commitment to the communities of Arizona and to society as a whole, has set a new standard for research universities, as modeled by the New American University. Accordingly, ASU is measured not by whom we exclude, but by whom we include.

The University is pursuing research that considers the public good and is assuming a greater responsibility to our communities for economic, social, and cultural vitality. Social embeddedness – university-wide, interactive, and mutually-supportive partnerships with Arizona communities – is at the core of our development as a New American University.

Toward the goal of social embeddedness, in response to the growing need of our communities to improve the public's safety and well-being, in July 2005 ASU established the Center for Violence Prevention and Community Safety. The Center's mission is to generate, share, and apply quality research and knowledge to create "best practice" standards.

Specifically, the Center evaluates policies and programs; analyzes and evaluates patterns and causes of violence; develops strategies and programs; develops a clearinghouse of research reports and "best practice" models; educates, trains, and provides technical assistance; and facilitates the development and construction of databases.

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