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# Impact of Legalizing Recreational Cannabis Sales on Cannabis Exposure Calls to Poison Centers 2008–2017

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## BACKGROUND

- During the past decade, nine states and the District of Columbia have legalized recreational (retail) cannabis.
- Each jurisdiction previously had a period where medical cannabis was legalized prior to legislation allowing legal adult recreational use.
- The purpose of this study was to examine the change over time in exposures to cannabis reported to poison centers, for any relation to the date of legalization of cannabis by state and across states.

## METHODS

- We collected dates of legal status changes by state including: decriminalization, medical use, and recreational use.
- Following approval by the AAPCC Data Access Committee, we examined the case logs for the 15 generic codes associated with marijuana/THC, and extracted all closed, human, single substance exposures from 1/1/2008 through 2/28/2018.
- Changes in exposure groups over time were examined by day, by week and by month (28 day period).
- Data management, descriptive statistics, graphical summaries, and the relationships (correlations and multivariate analyses) by state and across states were via SAS JMP 12.0.1.
- After screening analyses, exposure data for states with recreational laws were aligned by specific legal action day to examine the dynamics of the effect.

## RESULTS

- Between 1/1/2008 and 2/28/2018 there were 45,184 single substance exposures related to a cannabis product reported to US poison centers for the 15 Generic Codes (Table 1).
- Most exposures were seen at a healthcare facility and had minor or moderate effect (Figure 1).
- Male to female ratio of cases was 2.23:1, with largest age group age 20-60 years (Table 2).
- There was a spike in exposures ~week 400 (April 2016) for all states taken together (Figure 2). Principal contributors to this spike were THC/homologs (Figure 3). Of note, these THC/homolog exposures were most heavily reported from Mississippi, New York, New Jersey and Pennsylvania.
- Since our focus was changes in the effect of cannabis product laws, subsequent analyses excluded THC/homologs.
- Multivariate statistical modeling of exposures by month and by state showed statistically significant effects related to legalization of recreational cannabis in four states, legalization of medical cannabis in four states, and decriminalization of cannabis in three states (Table 3).
- An across state multivariate model assigned relative importance (LogWorth) of 1,154 to recreational, 2.53 to medical and none to decriminalization, suggesting that the largest effect on poison center cases was legalization of recreational cannabis rather than medical cannabis or decriminalization.
- We aligned the exposure data for the 10 regions (nine states & DC) with recreational laws by date of recreational cannabis law enactment to examine the profile of change in calls to poison centers (Table 4) and found an increase in cannabis-related poison center calls after legalization of recreational cannabis. Figure 4 shows the exposures by week with a spline fit (in the figure, week 0 is the date of enactment of legalized recreational cannabis sales).
- The statistical model that best described this response among the eight states with legalization before 1/1/2018 (Figure 5) included an overall increase in exposures (increase/year, [95% CI]) of 0.230 [0.058, 0.401] and the post-recreational slope (increase) of 1.42 [0.909, 1.93], a 6-fold increase after recreational law enactment. This suggests that states that legalized recreational cannabis sales saw an approximate 23% increase in poison center calls (harms).

## LIMITATIONS

- We restricted these exposures to single substance and have relatively little data after enactment of recreational laws, as well as relatively small numbers by state.

Generic Code	2008-17
Marijuana: Dried Plant (0203000)	18,988
Marijuana: Pharmaceutical Preparation (0200618)	370
Tetrahydrocannabinol (THC) Homologs (0200617)	24,823
eCigarettes: Marijuana Device Flavor Unknown (0310096)	25
eCigarettes: Marijuana Liquid With Added Flavors (0310036)	6
eCigarettes: Marijuana Device With Added Flavors (0310034)	2
eCigarettes: Marijuana Liquid Unknown (0310097)	26
Marijuana: Concentrated Extract (Including Oils and Tinctures) (0310124)	199
Marijuana: Edible Preparation (0310121)	633
Marijuana: Oral Capsule or Pill Preparation (0310122)	14
Marijuana: Other or Unknown Preparation (0310126)	80
Marijuana: Topical Preparation (0310125)	6
eCigarettes: Marijuana Device Without Added Flavors (0310033)	1
eCigarettes: Marijuana Liquid Without Added Flavors (0310035)	1
Marijuana: Undried Plant (0310123)	10
<b>Total (all 15 Generic Codes)</b>	<b>45,184</b>

Table 1. Cannabis Exposures Reported to Poison Centers 2008-2018 by Generic Code

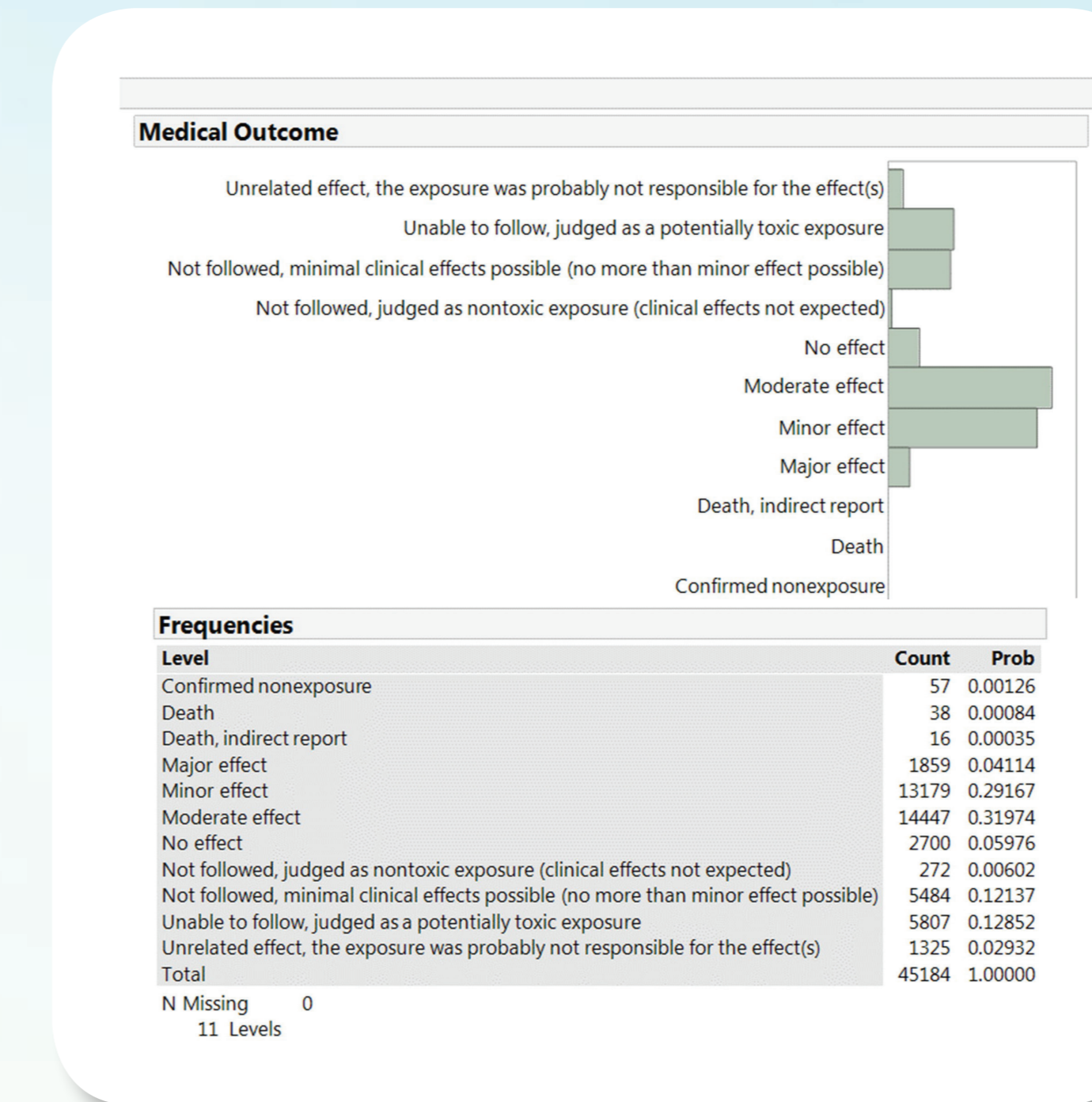


Figure 1. Medical Outcome for Cannabis Exposures Reported to Poison Centers 2008-2018

Age (years)	Age Group Num	Male	Female	Males/Females	Pregnant	Unknown
Unknown	0	2758	1734	1.59	7	155
0-5	1	1757	1558	1.13		53
6-12	2	673	404	1.67		41
13-19	3	9704	4244	2.29	4	38
20-60	4	15922	5884	2.71	34	143
61-120	5	37	34	1.09		
<b>ALL AGES</b>		<b>30851</b>	<b>13858</b>	<b>2.23</b>	<b>45</b>	<b>430</b>

Table 2. Cannabis Exposures Reported to Poison Centers 2008-2018 by Age and Sex

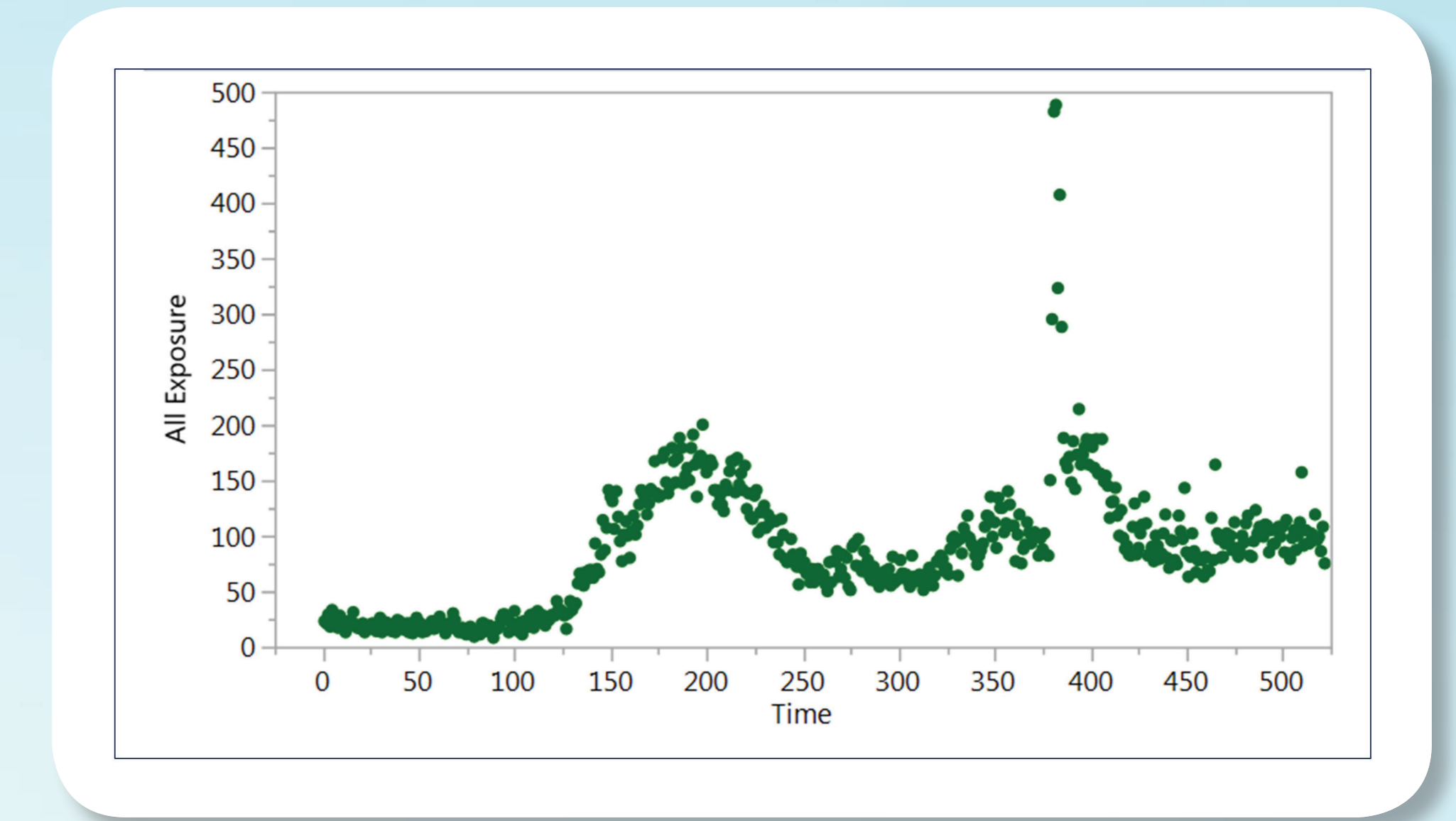


Figure 2. Change over Time (week number) of all Cannabis Exposures Reported to Poison Centers by Week from 1/1/2008 (2008-2018)

State	Recreational	Decriminalized	Medical	Months #	p-value	Number of Exposures	Months (observations)
California	0.1722	<.0001	<.0001	<.0001	<.0001	3842	134
Oregon	<.0001	<.0001	<.0001	<.0001	<.0001	811	122
Colorado	0.0413	<.0001	<.0001	<.0001	<.0001	993	126
Washington	0.1977	<.0001	<.0001	<.0001	<.0001	1360	183
Massachusetts	<.0001	0.3083	0.9579	0.0980	<.0001	795	107
Michigan	0.0197	<.0001	<.0001	<.0001	<.0001	743	128
Arizona	<.0001	<.0001	<.0001	<.0001	<.0001	716	129
Georgia	<.0001	<.0001	<.0001	<.0001	<.0001	397	118
New York	0.6563	<.0001	<.0001	<.0001	<.0001	3464	134
Florida	0.0057	<.0001	<.0001	<.0001	<.0001	965	132
Nevada	<.0001	0.7724	<.0001	<.0001	<.0001	186	71
Maryland	0.0204	0.2771	0.0414	<.0001	<.0001	428	117
Illinois	0.3215	0.0207	<.0001	<.0001	<.0001	178	123
New Mexico	<.0001	<.0001	<.0001	<.0001	<.0001	263	104
Pennsylvania	0.2177	0.0044	0.1748	<.0001	<.0001	506	130
Maine	0.0130	0.6480	<.0001	<.0001	<.0001	230	89
Connecticut	0.0130	0.6480	<.0001	<.0001	<.0001	197	91
Minnesota	0.0703	0.0110	<.0001	<.0001	<.0001	487	125
North Dakota	<.0001	0.7111	<.0001	<.0001	<.0001	21	19
Indiana	0.0002	0.000	0.000	0.000	0.000	282	113
New Hampshire	0.0001	0.5658	0.0001	0.001	0.001	449	122
North Carolina	0.2907	0.3709	0.002	0.002	0.002	264	101
Missouri	0.3463	0.0006	0.004	0.001	0.001	101	63
Kansas	0.0057	0.006	0.006	0.006	0.006	91	54
Ohio	0.0007	0.007	0.007	0.007	0.007	244	84
Utah	0.0171	0.017	0.017	0.017	0.017	63	42
Idaho	0.0276	0.027	0.027	0.027	0.027	480	124
Virginia	0.0254	0.025	0.025	0.025	0.025	88	53
Hawaii	0.0133	0.013	0.013	0.013	0.013	230	95
Tennessee	0.0416	0.042	0.042	0.042	0.042	102	71
South Carolina							

Table 3. Analysis of Variance (ANOVA) by Month and Legalization Status among States for which ANOVA p < 0.05 for Cannabis Exposures Reported to Poison Centers by Month (2008-2018)

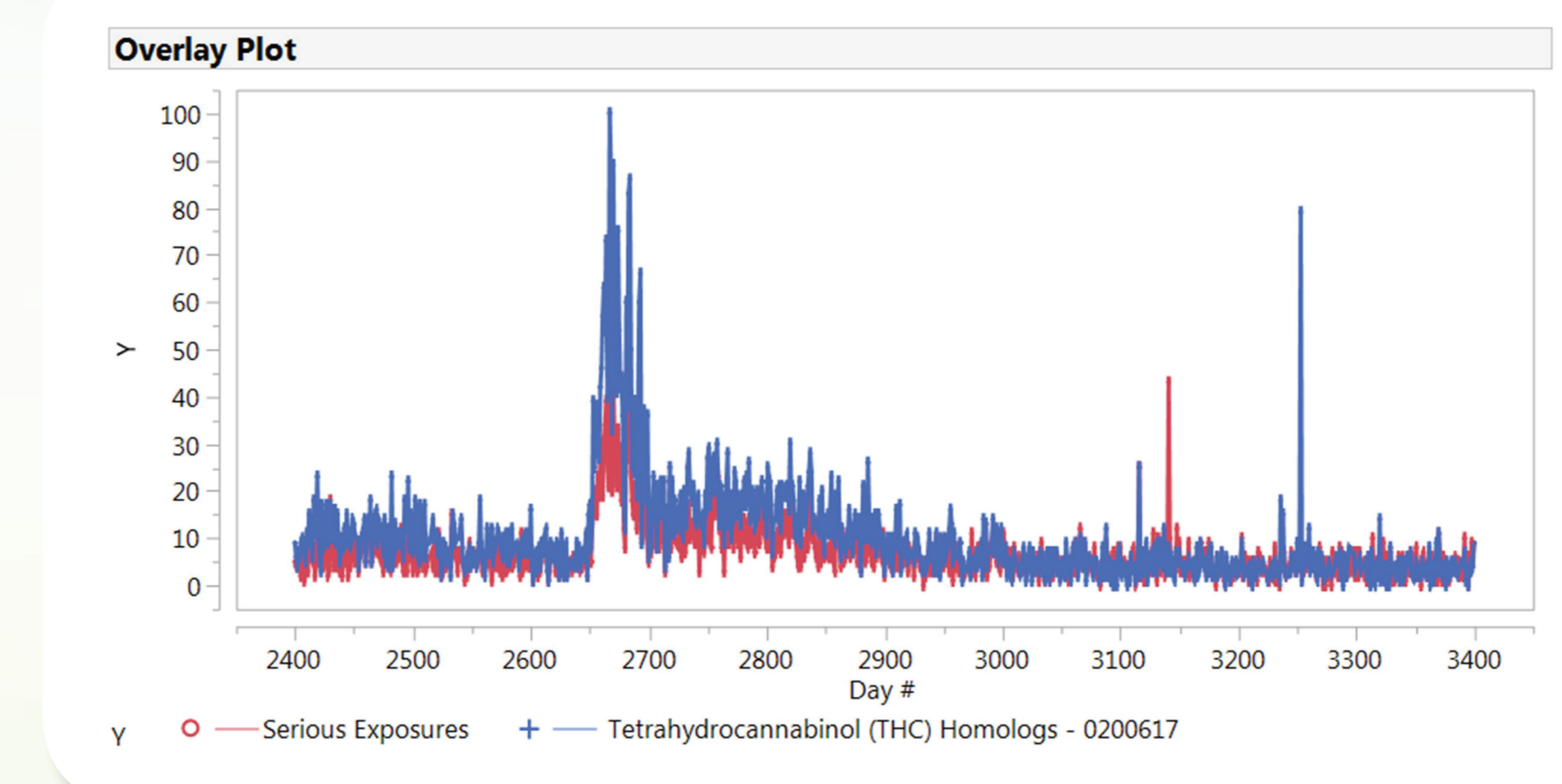


Figure 3. Overlay Plot of Serious Cannabis Exposures and THC Homologs Exposures Reported to Poison Centers by Day from 1/1/2008 (2008-2018)

State	Date	Marijuana Encounters (2008-2018)
Vermont (10)	1/22/2018	30
California (9)	1/1/2018	3311
Alaska	2/25/2015	61
Colorado	11/6/2012	993
District of Columbia	2/26/2015	92
Maine	11/9/2016	213
Massachusetts	11/8/2016	271
Nevada	11/8/2016	175
Oregon	7/1/2015	809
Washington	2/26/2015	1160
<b>Total (10 states)</b>		<b>7115</b>
<b>Total (9 states)</b>		<b>7085</b>
<b>Total (8 states)</b>		<b>3774</b>

Total 9 states = 8 states + California  
Total 10 states = 8 states + California + Vermont

Table 4. Exposures Reported to Poison Centers 2008-2018 for Ten States with Legalization of Recreational Cannabis (sorted by days since legalization)

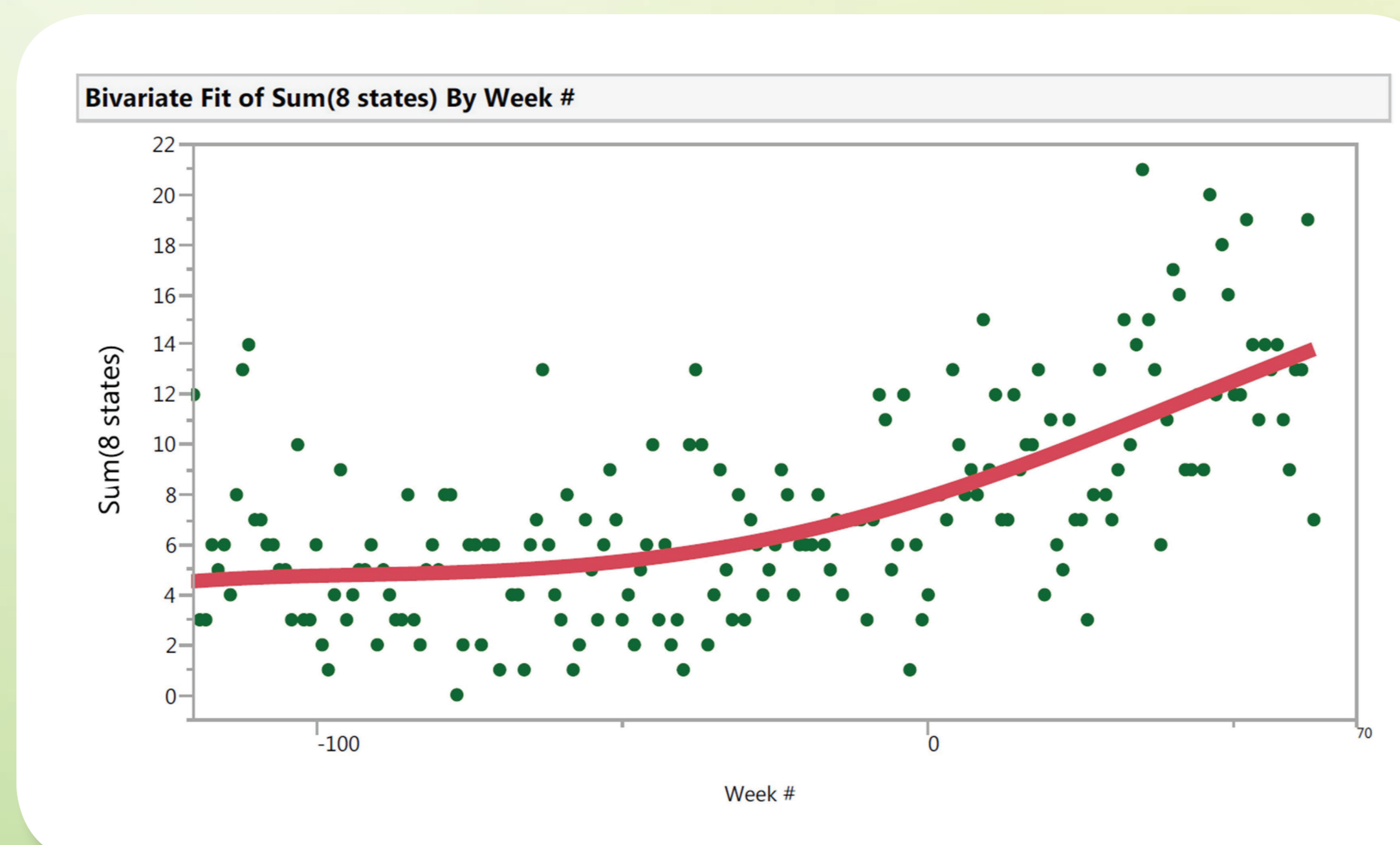


Figure 4. Exposures Reported to Poison Centers by Week 2008-2018: Spline Fit (lambda = 100) for 8 States aligned by Date of Legalization (Week 0) of Recreational Cannabis

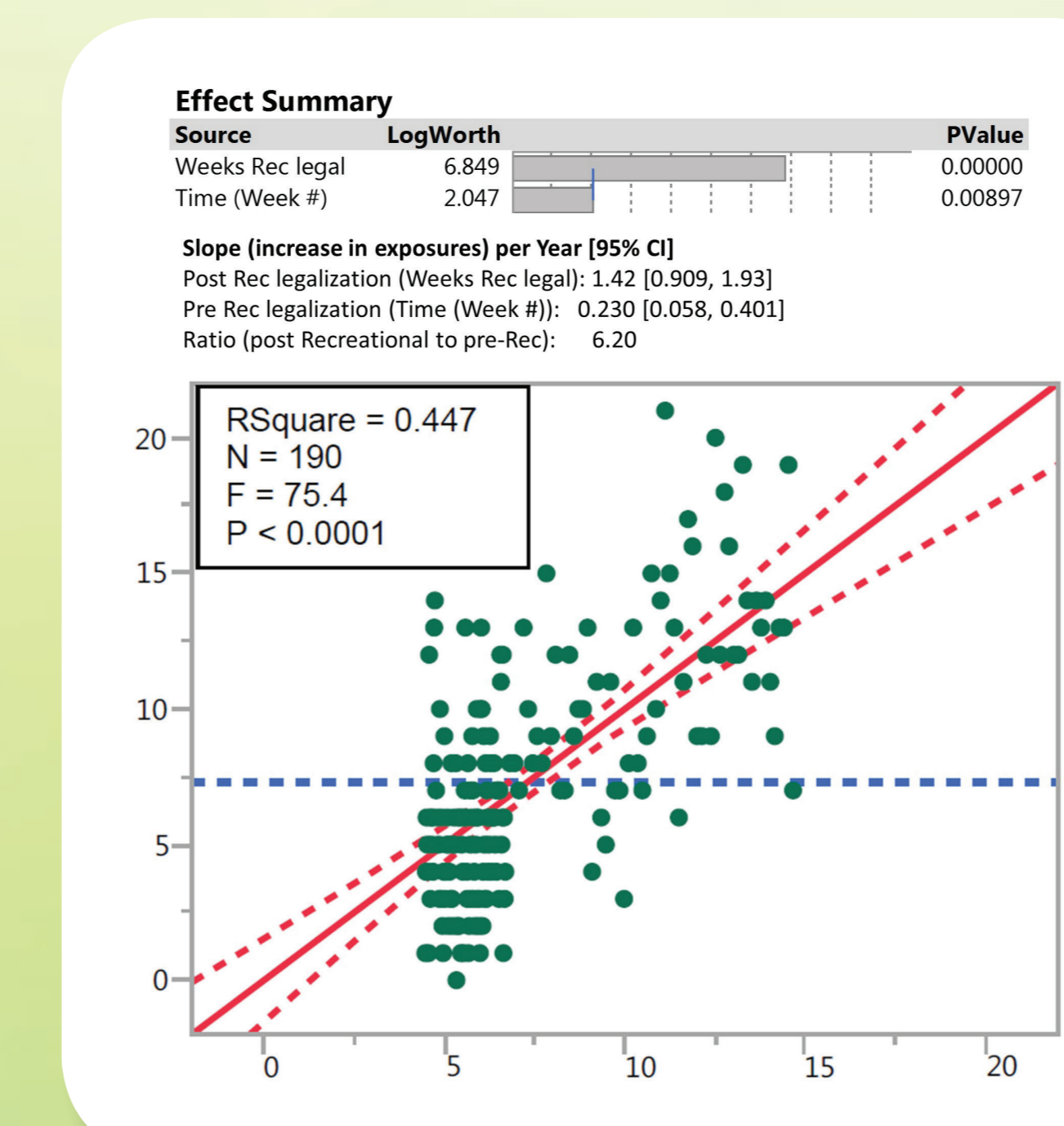


Figure 5. Actual (Y Axis) by Predicted (X Axis) Plot for Cannabis Exposures Reported to Poison Centers for 8 States with Legalization of Recreational Cannabis before 2018

## CONCLUSIONS

- States that legalized recreational cannabis saw an increase of 23% in cannabis-related poison center calls. These preliminary analyses indicate a strong relationship between the number of exposures to cannabis products that were reported to Poison Centers and the regulatory statutes for recreational >> medical > decriminalization.
- As more states change their regulatory status and time passes, exposure profiles can be better assessed.

