

## ONLINE FIRST

# Pediatric Marijuana Exposures in a Medical Marijuana State

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**Importance:** An increasing number of states are decriminalizing the use of medical marijuana, and the effect on the pediatric population has not been evaluated.

**Objective:** To compare the proportion of marijuana ingestions by young children who sought care at a children's hospital in Colorado before and after modification of drug enforcement laws in October 2009 regarding medical marijuana possession.

**Design:** Retrospective cohort study from January 1, 2005, through December 31, 2011.

**Setting:** Tertiary-care children's hospital emergency department in Colorado.

**Participants:** A total of 1378 patients younger than 12 years evaluated for unintentional ingestions: 790 patients before September 30, 2009, and 588 patients after October 1, 2009.

**Main Exposure:** Marijuana ingestion.

**Main Outcomes and Measures:** Marijuana exposure visits, marijuana source, symptoms, and patient disposition.

**Results:** The proportion of ingestion visits in patients younger than 12 years (age range, 8 months to 12 years) that were related to marijuana exposure increased after September 30, 2009, from 0 of 790 (0%; 95% CI, 0%-0.6%) to 14 of 588 (2.4%; 95% CI, 1.4%-4.0%) ( $P < .001$ ). Nine patients had lethargy, 1 had ataxia, and 1 had respiratory insufficiency. Eight patients were admitted, 2 to the intensive care unit. Eight of the 14 cases involved medical marijuana, and 7 of these exposures were from food products.

**Conclusions and Relevance:** We found a new appearance of unintentional marijuana ingestions by young children after modification of drug enforcement laws for marijuana possession in Colorado. The consequences of unintentional marijuana exposure in children should be part of the ongoing debate on legalizing marijuana.

*JAMA Pediatr.*

Published online May 27, 2013.

doi:10.1001/jamapediatrics.2013.140

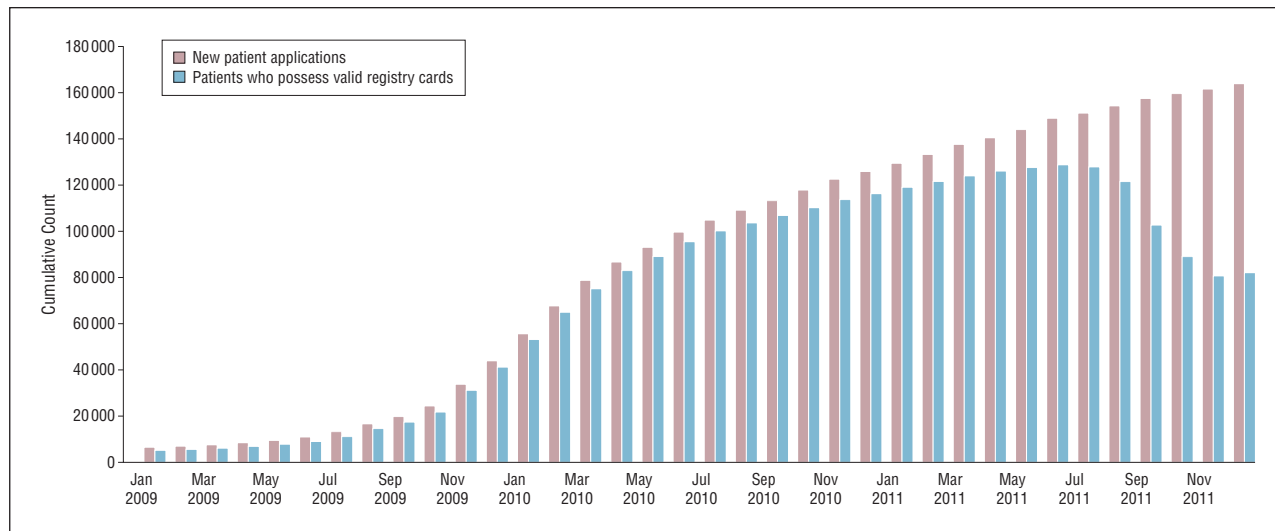
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**T**HE VIGOROUS DEBATE ON legalizing marijuana in the United States has received significant media attention, as evidenced by the 60 Minutes segment, "Medical Marijuana: Will Colorado's 'Green Rush' Last?" that aired on October 21, 2012.<sup>1</sup> Currently, 17 states and Washington, DC, have enacted laws to decriminalize medical marijuana at the state level despite being a Schedule 1 drug under the Controlled Substances Act. Most recently, in November 2012, Colorado and Washington passed amendments legalizing the recreational use of marijuana. In November 2000, Coloradoans passed Amendment 20, establishing the Medical Marijuana Registry, which opened in June 2001 under the auspices of the Colorado Department of Public Health and Environment. Since June 2001, there have been almost 160 000 total patient applica-

tions, and almost 89 000 patients currently possess valid registry ID cards (**Figure**). In October 2009, a new Justice Department policy instructed federal prosecutors not to seek arrest of medical marijuana users and suppliers as long as they conform to state laws.<sup>2</sup> In Colorado, this resulted in a sharp increase in the number of medical marijuana cards, with

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60 000 cards issued in 2009 compared with 2000 in the 8 years prior.<sup>3</sup> The mean age of a person with a medical marijuana card is 42 years, and 68% are male; 41 patients are younger than 18 years.<sup>2</sup> Reported conditions in patients using medical marijuana include cachexia, cancer, glaucoma, human immunodeficiency virus or AIDS, muscle spasms, seizures, severe pain, and severe nausea.<sup>1</sup> According to the Colo-



**Figure.** Colorado Department of Public Health and Environment's Marijuana Registry: new patient applications for medical marijuana cards and patients who possessed valid registry cards in Colorado, from January 1, 2009, through December 31, 2011.

rado Medical Marijuana Enforcement Division, as of October 2012, there are 204 medical marijuana dispensaries in the Denver metropolitan area (J. Postlethwait, BA, BS, oral communication, October 2012). The impact that decriminalizing medical marijuana has had on the use of marijuana is unclear. Although one study found higher adolescent marijuana use in medical marijuana states, a second study found no effect.<sup>4,5</sup> Neither study included younger pediatric exposures.

Historically, significant effects following unintentional pediatric marijuana ingestions were very rare, probably due to the poor palatability of the marijuana plant and the enforcement of existing drug laws. Previous literature consists of single case reports and a small case series.<sup>6-10</sup> However, tetrahydrocannabinol, the active chemical in marijuana, is incorporated into medical marijuana products in higher concentrations than typically found in the marijuana bud, the most potent part of the plant. In addition, medical marijuana is sold in baked goods, soft drinks, and candies. Therefore, we conducted a study to compare the number of marijuana exposures in a pediatric emergency department (ED) before and after the federal policy change in October 2009. On the basis of our clinical observation, we hypothesized that there would be a significant increase in pediatric marijuana exposures after October 2009.

## METHODS

This was a retrospective cohort study at a tertiary-care, freestanding children's hospital with an annual ED census of 65 000 visits. Inclusion criteria included patients younger than 12 years evaluated for ingestion from January 1, 2005, through December 31, 2011. Cases were identified by the following *International Classification of Diseases, Ninth Revision* codes: 930 to 939 (Effects of Foreign Body), 960 to 979 (Poisoning by Drugs, Medicinals, and Biological Substances), 980 to 989 (Toxic Effects of Substances Chiefly Nonmedicinal as to Source), E850 to E858 (Accidental Poisoning by Drugs, Medicinal Substances, and Biologics), E860 to E869 (Accidental Poisoning by Other Solid and Liquid Substances, Gases, and Vapors), and E910 to E915 (Accidents Caused

by Submersion, Suffocation, and Foreign Bodies). All marijuana exposures were confirmed by a urine toxicology screen.

Cases were reviewed by a single investigator (G.S.W.), and variables were abstracted onto a standardized data collection form. Abstracted variables included age, sex, date of visit, presenting chief complaint, laboratory work obtained, reported source of marijuana, and patient disposition. The proportion of poisoning cases related to marijuana between January 1, 2005, and September 30, 2009 (57 months), was compared with the proportion of cases between October 1, 2009, and December 31, 2011 (27 months).

Data were analyzed using SPSS, version 16.0 (SPSS, Inc) and SAS, version 9.2 (SAS Institute, Inc). Descriptive statistics were calculated. Medians with interquartile ranges were reported. Proportions were analyzed by the Fisher exact test. This study was approved by the Colorado Institutional Review Board, which granted a waiver of informed consent.

## RESULTS

From January 1, 2005, through September 30, 2009, 790 patients younger than 12 years were evaluated in the ED for suspected unintentional ingestions. The median age was 2.6 years (interquartile range, 1.6-3.0), and 449 (56.8%) were male. From October 1, 2009, through December 31, 2011, 588 patients younger than 12 years were evaluated in the ED for suspected unintentional ingestions. The median age was 2.3 years (interquartile range, 1.5-3.6), and 334 (56.8%) were male. The types of ingestions were similar between the 2 periods (**Table 1**).

Between January 1, 2005, and September 30, 2009, no patients younger than 12 years sought care at the ED for marijuana ingestions. Between October 1, 2009, and December 31, 2011, 14 patients younger than 12 years had confirmed marijuana ingestion by urine toxicology screen (**Table 2**). The proportion of exposure visits related to marijuana increased from 0 of 790 (0%; 95% CI, 0%-0.6%) to 14 of 588 (2.4%; 95% CI, 1.4%-4.0%) after September 2009 ( $P < .001$ ).

The age of the patients exposed to marijuana ranged from 8 months to 12 years, and 64.2% were male. The majority

of patients had central nervous system effects such as lethargy or somnolence with respiratory insufficiency as the most serious symptom. Most patients received an extensive workup, including blood work, radiographs, and lumbar punctures (Table 2). Only 2 patients had a history of marijuana ingestion, and they were the only patients who had minimal ancillary tests performed (urine toxicology screen). One patient was discharged from the ED, 5 patients were observed in the ED and eventually discharged, and 8 were admitted, with 2 admitted to the pediatric intensive care unit. Eight patients were exposed to medical

marijuana. In 3 patients, the source of the marijuana was never identified despite investigation. Seven of the medical marijuana exposures and 1 nonmedical marijuana exposure were from food products.

## DISCUSSION

We found a new increase in unintentional marijuana ingestions by young children after modification of drug enforcement laws for marijuana possession in Colorado. Most patients (92.8%) were admitted to or observed in the ED. In comparison, there were 1 207 575 exposures reported to US poison centers in 2010 in children younger than 5 years.<sup>11,12</sup> Of those patients, 109 611 (9.1%) were evaluated and discharged by a health care facility, and only 15 941 (1.3%) required admission.<sup>11,12</sup> This suggests that recent marijuana exposures are associated with more significant clinical effects than are typically reported with poisoning exposures in young children.

The increase in marijuana exposures in young children in Colorado is most likely due to the decriminalization of medical marijuana, which has resulted in an explosion of medical marijuana dispensaries and an increase in medical marijuana cards (Figure). Medical marijuana solicitation and advertising are ubiquitous throughout the state, with dispensaries throughout the Denver metropolitan area. In 2010, Denver issued more than 300 sales tax licenses for dispensaries, roughly twice the number of the city's public schools.<sup>13</sup>

**Table 1. Demographics of Patients Seen in the Children's Hospital Emergency Department for Ingestions<sup>a</sup>**

Characteristic	January 1, 2005, Through September 30, 2009	October 1, 2009, Through December 31, 2011
No. of patients	790	588
Age, median (IQR), y	2.6 (1.6-3.0)	2.3 (1.5-3.6)
Male sex	449 (56.8)	334 (56.8)
Types of ingestions		
Acetaminophen	90 (11.3)	48 (8.2)
Antihistamine	43 (5.4)	32 (5.4)
Antidepressant	23 (2.9)	14 (2.3)
Antitussive	18 (2.2)	14 (2.3)
Marijuana exposures	0	14 (2.3)

Abbreviation: IQR, interquartile range.

<sup>a</sup>Values are given as number (percentage) unless otherwise noted.

**Table 2. Pediatric Patients With Marijuana Exposures**

Case No./Sex/Age	Symptoms	Ancillary Tests	Disposition	Source of Marijuana
1/M/8 mo	Lethargy, rigidity	CMP, CBC, UA, Utox	Observation	Unknown
2/M/10 mo	Fussiness, somnolence	CMP, CBC, UA, amylase/lipase, Utox, CT head, c-spine x-rays, abdominal x-rays	Observation	POC medical marijuana
3/F/10 mo	Lethargy, hypoxic	CMP, CBC, UA, RSV, Utox, CT head, CXR, IV antibiotics	Admission	Unknown
4/M/1 y	Lethargy	BMP, CBC, Utox, CT head	Admission	POC with medical marijuana cigarette
5/M/2 y	Lethargy	UA, CMP, CBC, APAP/ASA levels, EKG, Utox, CT head, CXR	Admission	Babysitter with marijuana
6/M/2 y	Ataxia	CMP, CBC, UA, Utox, CT head, LP	Admission	Unknown
7/F/3 y	Lethargy	APAP/ASA levels, Utox, charcoal	Admission	FOC medical marijuana cookie
8/F/3 y	Lethargy	BMP, CBC, UA, Utox, CT head, CXR, LP	Admission	Family friend's medical marijuana cookie
9/M/3 y	Lethargy	BMP, CBC, APAP/ASA levels, valproic acid levels, Utox, CTH, VBG	Admission to PICU	GFOC medical marijuana cookie
10/F/3 y	Lethargy	Utox	Observation	FOC medical marijuana candy
11/M/4 y	Lethargy	UA, BMP, CBC, APAP/ASA levels, EKG, Utox	Observation	GMOC medical marijuana cookie
12/M/5 y	Respiratory insufficiency	CMP, CBC, APAP/ASA levels, EKG, Utox, CT head, VBG	Admission to PICU	GFOC marijuana
13/F/7 y	Asymptomatic	Utox	Discharge	GFOC medical marijuana cookie
14/M/12 y	Dizziness	BMP, CBC, EKG, Utox, rapid strep test	Observation	Marijuana cake

Abbreviations: APAP, acetaminophen; ASA, salicylate; BMP, basic metabolic panel; CBC, complete blood count; CMP, complete metabolic panel; c-spine, cervical spine; CT, computed tomography; CTH, head computed tomography; CXR, chest x-ray; EKG, electrocardiogram; FOC, father of child; GFOC, grandfather of child; GMOC, grandmother of child; IV, intravenous; LP, lumbar puncture; PICU, pediatric intensive care unit; POC, parents of child; RSV, respiratory syncytial virus; UA, urine analysis; Utox, urine toxicology screen; VBG, venous blood gas.

The increase in pediatric medical marijuana exposures may also be related to the improved palatability. Besides the plant and cigarette form, medical marijuana is sold in many products, including edibles such as candies, baked goods, and soft drinks, which presumably increases attractiveness to young children. In our study, most exposures were due to ingestion of medical marijuana in a food product. Many of these products contain higher concentrations of tetrahydrocannabinol than typically found in marijuana buds, resulting in symptomatic exposures despite small ingestions. Currently, there are no regulations on storing medical marijuana products in child-resistant containers, including labels with warnings or precautions, or providing counseling on safe storage practices.

While none of these exposures resulted in permanent morbidity or mortality, they caused significant clinical effects. Furthermore, when the diagnosis was unclear or the use of marijuana was not initially provided, children underwent multiple tests, procedures, and imaging during their ED evaluation. Because of a perceived stigma associated with medical marijuana, families may be reluctant to report its use to health care providers. Similar to many accidental medicinal pediatric exposures, the source of the marijuana in most cases was the grandparents, who may not have been available during data collection. Alternatively, the treatment team may fail to ask specifically about medical marijuana in the home.

Proponents of marijuana suggest that it is safer than ethanol. After September 2009, only 2 patients younger than 12 years were evaluated in the ED of the children's hospital for ethanol ingestion. One patient, an 11-year-old who intentionally ingested ethanol, was described as intoxicated; the other patient, a 2-year old who accidentally drank a household product that contained ethanol, was asymptomatic. During the study period, marijuana exposures resulted in more ED evaluations, hospital admissions, and clinical symptoms than did ethanol exposures.

There are some limitations to this study. This was a retrospective medical record review at a single tertiary-care children's hospital, so our findings may not be generalizable to other institutions. The data are from Colorado, and medical marijuana state laws vary, so our findings may not apply to other states. The abstractor of the medical records was not masked to the study question, which may have threatened the internal validity of the study. The abstracted data on the patients exposed to marijuana relied on previously collected medical record data and may have had missing information or details, including follow-up social work visits or police investigation. Patients may have been missed by our electronic medical record search.

In Colorado, the combination of decriminalizing medical marijuana and declining federal prosecution was associated with a significant increase in the exposure of young children to marijuana. Physicians, especially in states that have decriminalized medical marijuana, need to be cognizant of the potential for marijuana exposures

and be familiar with the symptoms of marijuana ingestion. This unintended outcome may suggest a role for public health interventions in this emerging industry, such as child-resistant containers and warning labels for medical marijuana. The consequences of marijuana exposure in children should be part of the ongoing debate on legalizing marijuana.

**Accepted for Publication:** December 12, 2012.

**Published Online:** May 27, 2013. doi:10.1001/jamapediatrics.2013.140

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**Author Contributions:** All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* All authors. *Acquisition of data:* Wang. *Analysis and interpretation of data:* All authors. *Drafting of the manuscript:* All authors. *Critical revision of the manuscript for important intellectual content:* All authors. *Statistical analysis:* Wang. *Administrative, technical, and material support:* Wang and Roosevelt. *Study supervision:* Roosevelt and Heard.

**Conflict of Interest Disclosures:** None reported.

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