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2021

## **Trends and Characteristics of Manufactured Cannabis Product and Cannabis Plant Product Exposures Reported to US Poison Control Centers, 2017-2019**

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# Trends and Characteristics of Manufactured Cannabis Product and Cannabis Plant Product Exposures Reported to US Poison Control Centers, 2017-2019

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## Introduction

Legalization of adult use cannabis products has led to a consumer-driven marketplace. A growing share of retail cannabis sales are manufactured cannabis products,<sup>1</sup> which may contain higher levels of tetrahydrocannabinol (THC) than unprocessed cannabis plant materials,<sup>2</sup> resulting in greater short-term effects (eg, cognitive and psychomotor impairment).<sup>3</sup> Public health concerns are emerging about these risks.<sup>4</sup> Our study objective was to assess recent patterns in reports of cannabis-related exposures by product type.

## Methods

For this cross-sectional study, we accessed National Poison Data System data on cannabis exposures reported to US poison centers for January 2017 through December 2019. Cannabis product type codes were added to the system in 2016. We compared trends and characteristics of exposures for manufactured products that require processing of plant materials (eg, concentrates, edibles, vaporized liquids) and unprocessed plant materials (eg, flower) (eMethods in the [Supplement](#)). Two-sided *P* values <.05 were considered statistically significant. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for cross-sectional studies. The institutional review board at Washington State University determined this study was exempt from review because it used deidentified data.

## Results

Among the total 28 630 exposures, plant materials were the most commonly involved (18 763 exposures [65.5%]), followed by edibles (5537 [19.3%]), concentrates (2734 [9.6%]), vaporized liquids (1075 [3.8%]), and other manufactured products (521 [1.8%]) (**Table**).

Manufactured product exposure cases more often involved children: 2505 cases (27.0%) involved patients under 10 years old, compared with 1490 plant-based exposures (8.4%). Exposures to edibles had the greatest proportion of children (1905 exposures [36.6%]). More than half of all calls were made from a health care facility; manufactured product calls came from a residence nearly twice as often as plant-based exposure calls (3927 [39.8%] vs 3817 [20.3%]; *P* < .001).

Most manufactured cannabis product exposures were for those products alone (8040 exposures [81.5%]). In contrast, most plant exposures (11 556 [61.6%]) also involved other agents (eg, alcohol, other drugs). Among exposures where only cannabis was involved, a slightly smaller percentage of manufactured product exposures overall (2918 [36.3%]) were associated with serious medical outcomes compared with plant-based exposures (2803 [38.9%]). Vaporized liquid exposures were most likely to have serious medical outcomes (268 [42.3%]).

During 2019, population-based rates for manufactured cannabis product exposures overall and for most specific products were greater where adult cannabis use was legal. One exception was vaping: exposure calls per 100 000 population were 0.29 in nonlegal states (692 total exposures) and 0.21 in legal states (195 total exposures).

## + Supplemental content

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Table. Characteristics of Cannabis-Related Exposures Reported to US Poison Centers by Cannabis Product Type, January 2017 to December 2019

Characteristic	Exposures, No. (%)						P value
	Specific manufactured products				General product categories		
	Concentrates (n = 2734)	Vaporized liquids (n = 1075)	Edibles (n = 5537)	Other (n = 521)	Total manufactured (n = 9867)	Plant materials (n = 18 763)	
<b>Total</b>							
2017	275 (10.1)	33 (3.1)	697 (12.6)	89 (17.1)	1094 (11.1)	7146 (38.1)	<.001
2018	1002 (36.7)	151 (14.1)	1943 (35.1)	174 (33.4)	3270 (33.1)	6011 (32.0)	
2019	1457 (53.3)	891 (82.9)	2897 (52.3)	258 (49.5)	5503 (55.8)	5606 (29.9)	
<b>Age group</b>							
Children (<10 y)	423 (16.6)	77 (7.5)	1905 (36.6)	100 (20.3)	2505 (27.0)	1490 (8.4)	<.001
Youth (10-20 y)	999 (39.1)	551 (53.6)	1561 (30.0)	95 (19.3)	3206 (34.5)	7 369 (41.3)	
Adults (≥21 y)	1134 (44.4)	400 (38.9)	1746 (33.5)	297 (60.4)	3577 (38.5)	8 984 (50.4)	
<b>Caller site</b>							
Health care facility	1375 (50.3)	644 (59.9)	2676 (48.3)	248 (47.6)	4943 (50.1)	13 624 (72.6)	<.001
Residence	1100 (40.2)	373 (34.7)	2230 (40.3)	224 (43.0)	3927 (39.8)	3817 (20.3)	
Other	243 (8.9)	52 (4.8)	570 (10.3)	47 (9.0)	912 (9.2)	1206 (6.4)	
Unknown	16 (0.6)	6 (0.6)	61 (1.1)	2 (0.4)	85 (0.9)	115 (0.6)	
<b>Coingestants</b>							
Cannabis only	2138 (78.2)	633 (58.9)	4898 (88.5)	371 (71.2)	8040 (81.5)	7207 (38.4)	<.001
Polysubstances	596 (21.8)	442 (41.1)	639 (11.5)	150 (28.8)	1827 (18.5)	11 556 (61.6)	
<b>Medical outcome<sup>a</sup></b>							
Minor or less	1369 (64.0)	365 (57.7)	3114 (63.6)	274 (73.9)	5122 (63.7)	4404 (61.1)	.001
Moderate or greater	769 (36.0)	268 (42.3)	1784 (36.4)	97 (26.2)	2918 (36.3)	2803 (38.9)	
<b>Legal status of state (2019 exposures only)<sup>b</sup></b>							
Not legal	946 (65.4)	692 (78.0)	1328 (46.5)	153 (59.3)	3119 (57.3)	3806 (68.7)	<.001
Rate per 100 000	0.40	0.29	0.56	0.07	1.33	1.62	
Adult use legal	501 (34.6)	195 (22.0)	1528 (53.5)	105 (40.7)	2329 (42.8)	1735 (31.3)	
Rate per 100 000	0.54	0.21	1.64	0.11	2.50	1.86	
Quarterly slope coefficients (95% CI) <sup>c</sup>	35.2 (22.5 to 47.8)	27.8 (13.1 to 42.4)	67.8 (58.8 to 76.8)	4.7 (1.7 to 7.7)	33.9 (17.7 to 50.0)	-45.3 (-67.1 to -23.6)	<.001 <sup>d</sup>

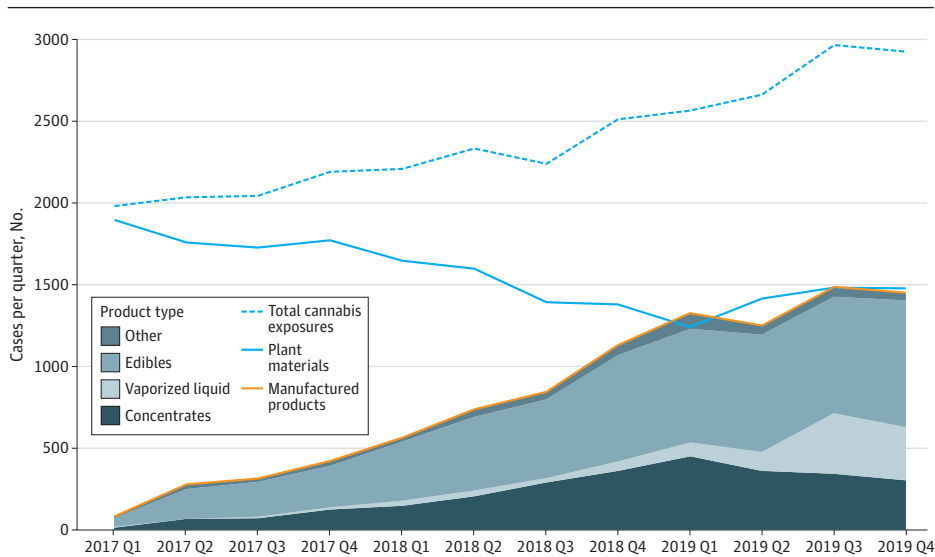
<sup>a</sup> Excludes cases with coingestants (ie, only includes cannabis exposures alone).

<sup>c</sup> Quarterly slope coefficients are from a linear regression of counts per quarter.

<sup>b</sup> States with legal adult use in 2019 included: Alaska, California, Colorado, Illinois, Massachusetts, Maine, Michigan, Nevada, Oregon, Vermont, Washington State, and Washington, DC.<sup>6</sup>

<sup>d</sup> P value is for an interaction term between time and manufactured products group in a difference-in-difference model.

Figure. Quarterly Number of Cannabis-Related Poison Center Calls by Product Type, January 2017 to December 2019



Total cannabis exposures increased between 2017 and 2019. However, quarterly plant-related exposure reports declined over time, while manufactured product exposure reports increased overall and for each specific product (Figure).

## Discussion

Our findings document that US poison centers are increasingly receiving calls about adverse events associated with exposures to manufactured cannabis products. Higher rates in legal states suggest that continued increases may be expected with adult cannabis use legalization in more states.

Children may be at particular risk for exposure to edible products, such as cookies or candy. Although we did not see more serious health outcomes for manufactured product exposures compared with plant products overall, most cannabis plant exposures involved polysubstance use, whereas most cases for manufactured products were for those products alone, suggesting that exposure to manufactured products alone may be relatively more likely to generate adverse events. This is consistent with studies of acute health effects.<sup>3</sup>

Manufactured products may present risks both because of THC levels and other processing ingredients. For example, vaporized liquid additive ingredients were implicated in a 2019 national lung injury (e-cigarette or vaping use-associated lung injury [EVALI]) outbreak.<sup>5</sup>

Market factors may drive the industry to continue developing novel products, which could present additional health risks. Applying regulatory controls to market-driven innovations in potency and additives is key. Novice cannabis users are often advised to “start low, go slow”; this guidance may be equally applicable to regulating new retail cannabis markets and products.

This study was limited by its data source. Poison centers provide useful information about specific product exposures and medical outcomes; however, data are self-reported and may underestimate the burden of cases. Ongoing monitoring of manufactured product-specific adverse events is recommended to understand public health concerns and effectiveness of regulations or harm reduction messaging.

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## ARTICLE INFORMATION

**Accepted for Publication:** March 30, 2021.

**Published:** May 24, 2021. doi:10.1001/jamanetworkopen.2021.10925

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**Author Contributions:** Dr Dilley had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

*Concept and design:* Dilley, Graves, Brooks-Russell, Whitehill.

*Acquisition, analysis, or interpretation of data:* Dilley, Graves, Whitehill, Liebelt.

*Drafting of the manuscript:* Dilley.

*Critical revision of the manuscript for important intellectual content:* All authors.

*Statistical analysis:* Dilley.

*Obtained funding:* Graves.

*Administrative, technical, or material support:* Dilley, Graves, Liebelt.

*Supervision:* Graves, Liebelt.

**Conflict of Interest Disclosures:** Dr Graves reported receiving grants from the Alcohol and Drug Abuse Research Program at Washington State University; she reported serving on the board of directors for the Washington Poison Center outside the submitted work. Dr Whitehill reported receiving consulting fees from Washington State University during the conduct of the study. Dr Liebelt reported receiving consulting fees from Washington State University during the conduct of the study and a grant given her organization (Washington Poison Center) from Verdant Health Commission to develop curriculum and education on harmful effects of cannabis. No other disclosures were reported.

**Funding/Support:** This investigation was supported in part by funds provided for medical and biological research by the State of Washington (initiative measure No 171). Support for Dr Dilley was provided in part by the National Institute on Drug Abuse of the National Institutes of Health (award No 1R01DA039293).

**Role of the Funder/Sponsor:** The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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## SUPPLEMENT.

eMethods.