Monitoring Health Concerns Related to Marijuana in Colorado:2020

January 2021

www.marijuanahealthinfo.colorado.gov

Contents

About this summary

This summary was prepared by the Marijuana Health Monitoring Program at the Colorado Department of Public Health and Environment on behalf of the Retail Marijuana Public Health Advisory Committee. The information contained herein summarizes the key findings from our report website www.marijuanahealthinfo.colorado.gov. Our report website and this 2020 report summary are provided to the Colorado State Board of Health, the Colorado Department of Revenue, and the Colorado General Assembly by the Retail Marijuana Public Health Advisory Committee pursuant to:

C.R.S. 25-1.5-110. Monitor health effects of marijuana - report

Source C.R.S. § 25-1.5-110 (Lexis Advance through all laws passed during the 2020 Legislative Session)

> "The department shall monitor changes in drug use patterns, broken down by county or region, as determined by the department, and race and ethnicity, and the emerging science and medical information relevant to the health effects associated with marijuana use.
>
> The department shall appoint a panel of health care professionals with expertise in, but not limited to, neuroscience, epidemiology, toxicology, cannabis physiology, and cannabis quality control to further direct policy. The panel shall provide a report by January 31, 2015, and every two years thereafter to the state board of health, the department of revenue, and the general assembly. The department shall make the report available on its website. The panel shall establish criteria for studies to be reviewed, reviewing studies and other data, and making recommendations, as appropriate, for policies intended to protect consumers of marijuana or marijuana products and the general public.
>
> In order to allow the public to evaluate any conflict of interest among the panel, each panelist shall disclose all financial interests the panelist has related to the health care industry and the regulated marijuana industry. The disclosures must be included in the report.
>
> The department may collect Colorado-specific data that involves health outcomes associated with cannabis from, but not limited to, all-payer claims data, hospital discharge data, and available peer-reviewed research studies."

Retail Marijuana Public Health Advisory Committee 2019-2020

Members

Chairperson: A. Elyse Contreras, MPH, Manager of Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment

Shireen Banerji, PharmD, DABAT, Director, Rocky Mountain Poison and Drug Safety

Laura Borgelt, PharmD, Associate Dean and Professor, Departments of Clinical Pharmacy and Family Medicine, University of Colorado Anschutz Medical Campus

Russell Bowler, MD, PhD, Professor of Medicine, National Jewish Health and University of Colorado

Ashley Brooks-Russell, PhD, MPH, Assistant Professor, Colorado School of Public Health; Co-director, Program for Injury Prevention, Education and Research

Christopher Domen, PhD, Neuropsychologist, University of Colorado Hospital; Assistant Professor, University of Colorado School of Medicine Department of Neurosurgery

Rebecca Helfand, PhD, Program Director, Behavioral Health Unit, Western Interstate Commission for Higher Education

Heather Krug, MS, Manager of Cannabis Sciences Program, Colorado Department of Public Health and Environment Laboratory

David J. Kroll, PhD, Professor and Co-director of Cannabis Science and Medicine Programs, University of Colorado Skaggs School of Pharmacy and Pharmaceutical Sciences

Sharon Langendoerfer MD, Retired Pediatrician and Neonatologist, Denver Health Medical Center

Andrew Monte, MD, PhD, Emergency Medicine Physician and Medical Toxicologist, University of Colorado and the Rocky Mountain Poison and Drug Safety

Judith Shlay, MD, MSPH, Associate Director, Denver Public Health; Professor of Family Medicine, University of Colorado School of Medicine

Scott A. Simpson, MD, MPH, Medical Director, Psychiatric Emergency Services, Denver Health Medical Center

Elizabeth 'Libby' Stuyt, MD, Addiction Psychiatrist; Clinical faculty, University of Colorado at Colorado Springs Health Sciences Center, Department of Psychiatry

George Sam Wang, MD, Assistant Professor of Pediatrics, Department of Pediatrics, Section of Emergency Medicine and Medical Toxicology, University of Colorado Anschutz Medical Campus and Children's Hospital Colorado, Rocky Mountain Poison and Drug Safety

Colorado Department of Public Health and Environment technical staff

DeLayna Goulding, MPH, Statistical Analyst and Epidemiologist, Marijuana Health Monitoring Program

Richard Holdman MD, MPH, Medical Consultant, Marijuana Health Monitoring Program

Conflicts of interest

Conflict of interest statements for Retail Marijuana Public Health Advisory Committee members may be found on our report website www.marijuanahealthinfo.colorado.gov.

Contact

marijuanainfo@state.co.us

Introduction

Background

It has been nearly nine years since Colorado became one of the first two states in the nation to legalize retail marijuana in November 2012. Since then, many states have followed suit by either decriminalizing or legalizing marijuana to varying degrees. When the Colorado General Assembly mandated the Colorado Department of Public Health and Environment (CDPHE) begin monitoring the public health effects of retail marijuana in 2014, little was it known at that time Colorado would become a leader by setting an example for others to follow. Today, Colorado is recognized nationally and internationally for how we monitor the public health impact of marijuana legalization.

This report summary presents the major findings from the latest data collected and scientific evidence available through 2020. Our key objectives are to help facilitate evidence-based policy decisions and science-based public education in Colorado. The data we analyze come from validated sources and the findings are interpreted by individuals formally trained in epidemiology and biostatistics. The health statements and recommendations we make are produced from the collective expertise of the Retail Marijuana Public Health Advisory Committee and are directly reflective of the science from which it came, unbiased by individual opinion. This report summary presents a condensed version of the data findings important to public health, heath statements of moderate to substantial significance, and the recommendations for continued surveillance improvement and policy influence.

Changes since our last report

In this section, we highlight notable changes we have made and events that have occurred since our last report that was released in January 2019.

EVALI

Since August 2019, CDPHE has investigated 48 potential cases of E-cigarette or Vaping product use Associated Lung Injury (EVALI), reporting eight confirmed cases with the last case being confirmed in November, 2019. Three cases (37.5%) reported using tetrahydrocannabinol (THC) vaping products exclusively, four (50%) reported vaping nicotine products exclusively, and one (12.5%) reported vaping an unknown product. All eight patients were hospitalized with a medium length of stay of 5.5 days and all had CT scans and chest X-rays performed while hospitalized showing infiltrates/opacities present. Three cases (37.5%) required intensive care unit (ICU) admissions and seven (87.5%) required

respiratory support while hospitalized. All of the cases presented with various respiratory symptoms, such as shortness of breath, pleuritic chest pain, cough, dyspnea, and hypoxia. Three cases (37.5%) presented with gastrointestinal symptoms, such as nausea, vomiting, diarrhea, and abdominal pain. Five cases (62.5%) also presented with constitutional symptoms, such as fever, fatigue, malaise, myalgias, and chills. Colorado did not report any deaths related to EVALI, although one death was investigated but was determined by the Centers for Disease Control and Prevention (CDC) not to be an EVALI-related case. Coordinating with the CDC, data from case reports and product testing across the United States show THC-containing e-cigarettes are linked to EVALI cases and play a major role in this outbreak. Specifically, products bought from informal sources, such as friends, family, or online dealers, and those containing Vitamin E acetate are linked to EVALI.

THC concentration

During the 2019 Colorado legislative session, the General Assembly requested CDPHE to study "…tetrahydrocannabinol (THC) potency of marijuana and any health effects." In a request for information submitted through the Long Bill in Footnote 88a, CDPHE was instructed to have the Retail Marijuana Public Health Advisory Committee (RMPHAC) review the scientific literature, plus relevant data, and present a report with recommendations to the General Assembly by July 31, 2020. The report *THC Concentration in Colorado Marijuana* is available on our report website at: www.marijuanahealthinfo.colorado.gov/reports-and-summaries

New time points for comparison

For our 2020 report and summary, we examined our data with three different time points in mind; changes in data since the last year the data were collected, changes in data since our last report, and changes in data since 2014 - the year the retail marijuana market place opened in Colorado. We did this to give our readers different perspectives and a better understanding of how retail marijuana has changed or not changed the health of Coloradans.

New questions examined

Acting on the recommendations from our 2018 report, we have included questions from our survey data that assess the perceived risk of marijuana use/consumption and certain behaviors or attitudes that are indicative of protective factors. The data from these questions measure changes in perceptions of harm over time and help to inform prevention strategy.

Acknowledging and applying health equity and social justice

CDPHE acknowledges that long-standing systemic racism, including economic and environmental injustice, has created conditions that negatively affect marginalized communities, particularly people of color. These conditions, which limit opportunities for optimal health and influence individual behaviors, are critical predictors of health outcomes. To realize a future where all Coloradans can thrive, we must be leaders in undoing policies and practices that have contributed to these inequities.

In this summary and throughout our report website, we applied the term 'consumer' where appropriate to remove any negative connotation associated with the terms "use" and "user" among individuals who consume legal substances. Use of the terms "use" and "user" do remain, but were only applied when referring to illicit substance abuse, licit substance misuse, or among individuals under the legal age of substance consumption in Colorado.

Section 1: Monitoring Changes in Marijuana Use Patterns

Background

The Colorado Department of Public Health and Environment (CDPHE) was given statutory responsibility in 25-1.5-110, C.R.S. to:

> "… monitor changes in drug use patterns, broken down by county or region, as determined by the department, and race and ethnicity, and the emerging science and medical information relevant to the health effects associated with marijuana use."

Patterns of drug use are typically determined by using population-based surveys that ask specific questions about substance use and consumption. Colorado has several population-based surveys to assess the prevalence of a variety of health conditions and behaviors of specific populations. In addition, there are national population-based surveys that collect state-level data on marijuana use and consumption. The data from these surveys are compiled here to meet the reporting requirements set forth in 25-1.5-110, C.R.S. Reviewing marijuana use/consumption patterns in Colorado provides important insight to members of the Retail Marijuana Public Health Advisory Committee as they consider public health recommendations.

Data sources

Adult consumption/use: Behavioral Risk Factor Surveillance System (BRFSS)

The Behavioral Risk Factor Surveillance System (BRFSS) is a telephone survey of adults ages 18 years and older, sponsored by the CDC. It is the nation's premier system of health-related telephone surveys that collect data from U.S. residents regarding their health-related risk behaviors, chronic health conditions and safety practices. CDPHE, in a cooperative agreement with CDC, manages and administers BRFSS annually in Colorado. Beginning in 2014, Colorado added questions about marijuana use/consumption to the state-level BRFSS and has continued to include them in subsequent years.

Marijuana in homes with children: Child Health Survey

The Child Health Survey is an online survey conducted among respondents to the BRFSS Survey who have children ages 1-14 in their home. Adult respondents answer questions about their children and

the home environment. This annual survey provides data on a wide range of health issues and risk factors affecting children and youth in Colorado. Since 2014, questions about marijuana use/consumption and storage in the home have been included in the survey.

Adolescent and young adult use: Healthy Kids Colorado Survey (HKCS)

The Healthy Kids Colorado Survey (HKCS) collects health information from public high school and middle school students. It is a voluntary, anonymous survey, completed by students individually in their classrooms, and parents are notified ahead of time. HKCS is a collaboration of CDPHE, the Colorado Department of Education, and the Colorado Department of Human Services. This survey is conducted every odd-year and includes questions from the national Youth Risk Behavior Surveillance System (YRBSS). HKCS has included questions on marijuana since 2013.

Adolescent and adult use: National Survey on Drug Use and Health (NSDUH)

The Substance Abuse and Mental Health Services Administration (SAMHSA) tracks national and state-level data on tobacco, alcohol, marijuana, and illicit drug use through the National Survey on Drug Use and Health (NSDUH). This annual survey is completed by an in-person interview at the respondent's home and includes one or two residents who are at least 12 years old. NSDUH is the only data source that estimated past 30-day marijuana use among adults prior to legalization in Colorado. Although the survey design differs and is not the ideal comparison to BRFSS and HKCS, it can be used as an indicator for state and national marijuana use/consumption estimates. NSDUH marijuana use/consumption estimates are included in this report for comparison purposes.

Use during pregnancy: Pregnancy Risk Assessment Monitoring System (PRAMS)

The Pregnancy Risk Assessment Monitoring System (PRAMS) is an annual survey of women who recently gave live birth. It is sponsored by the CDC and administered by CDPHE in Colorado on an annual basis. PRAMS provides data about maternal and child health indicators, such as unintended pregnancy, prenatal care, breastfeeding, infant health, smoking and alcohol use during pregnancy and the first few months after delivery. In 2014, Colorado added questions about marijuana use/consumption before, during, and after pregnancy to the state-level PRAMS.

Adolescent and young adult use: Youth Risk Behavior Surveillance System (YRBSS)

The Youth Risk Behavior Surveillance System is the national, biennial survey of high school students sponsored by the CDC. YRBSS is an in-school survey administered by health and/or education agencies in every state and is representative of students attending high school grades nine through 12 in the U.S. In Colorado, YRBSS questions are included in the Healthy Kids Colorado Survey (HKCS) and can

therefore be directly compared. YRBSS is the preferred survey for this comparison since it and HKCS both include the same questions and use the same survey methodology and administration.

Data limitations

These surveys rely on self-reported information, so there is no way to confirm whether each respondent has answered truthfully. These types of surveys have been validated in various studies, which indicate most people do answer truthfully. Consistency in methodology from year to year for each of the surveys provides confidence that trends over time can be effectively monitored.

Survey key details

Survey	Population and ages studied	Years with marijuana questions	Data collection method
BRFSS	Adults age 18 and up	2014-2019	Telephone survey
CHS	Parents of children ages 1-14	2018-2019	Online survey
HKCS	Middle and high school students in sixth -12th grades	2013-2019	In-school paper survey
YRBSS	High school students in ninth -12th grades	1991-2019	In-school survey
NSDUH	Adolescents and adults ages 12 and up	1971-2019	In-person, at home survey
PRAMS	Recently pregnant women of all ages	2014-2018	Mailed paper and telephone survey

Summary of key findings

This section highlights prominent findings from all surveys capturing marijuana use/consumption in Colorado. All findings and detailed results of the surveys can be found at: www.marijuanahealthinfo.colorado.gov

Trends in adult marijuana use/consumption in Colorado

Past 30-day marijuana use/consumption continues to increase among Colorado adults

Since our last report, past 30-day marijuana use/consumption among Colorado adults ages 18 years and older significantly increased from 15.5% in 2017 to 19.0% in 2019 (***Figure 1***). Adult marijuana use/consumption has also significantly increased nationally from 9.5% in 2017 to 11.9% in 2019, but remains significantly lower compared to Colorado. From 2018 to 2019, marijuana use/consumption among Colorado adults remained stable across all regions of the state. Since retail marijuana became available in Colorado in 2014, marijuana use/consumption among Colorado adults has significantly increased from 13.6% reported in 2014. Past 30-day adult marijuana use/consumption in Colorado has consistently remained significantly higher compared to the U.S. since 2014.

In 2019, past 30-day marijuana use/consumption remained highest among younger Colorado adults ages 18 to 25 years (28.8%) and 26 to 34 years (29.4%). However, since our last report there were significant increases in consumption among older Colorado adults ages 35 to 64 (12.8% in 2017 to 17.3% in 2019) and ages 65 years and older (5.6% in 2017 to 9.3% in 2019). Smoking marijuana remained the most prevalent method of marijuana use/consumption among Colorado adults (14.4%) followed by eating/drinking (8.1%), vaporizing (6.1%), dabbing (3.7%), and using other methods (2.2%) in 2019 (***Figure 2***).

Since 2014, past 30-day marijuana use/consumption has significantly increased among white, non-Hispanic (14.1% in 2014 to 20.1% in 2019) Colorado adults. Past 30-day marijuana use/consumption has also significantly increased since 2014 among both Colorado adult males (17.2% in 2014 to 22.9% in 2019) and adult females (10.0% in 2014 to 15.1% in 2019), although use/consumption has consistently been significantly higher among adult males. Additionally, past 30-day marijuana use/consumption has consistently remained significantly higher since 2014 among Colorado adults who identify as gay, lesbian, bisexual, or other.

Daily or near daily consumption increasing in Colorado adults

Since our last report, there was a significant increase in daily or near daily marijuana use/consumption among all Colorado adults (7.6% in 2017 to 9.1% in 2019; ***Figure 3***). Since 2018, the

prevalence of daily or near daily adult marijuana use/consumption was no different than daily adult cigarette smoking with both at about 9.0% in 2019. The prevalence in 2019 of Colorado adults who reported using/consuming marijuana daily or near daily (9.1%) remained significantly higher compared to reported weekly use (6.0%) and monthly use/consumption (3.8%). From 2018 to 2019, daily or near daily use among Colorado adults remained stable across all regions of the state.

In 2019, daily or near daily marijuana use/consumption remained highest among younger Colorado adults, ages 18 to 25 years (14.1%) and ages 26 to 34 years (15.7%), with no significant difference between the two age groups. Since our last report, there was a significant increase in daily or near daily marijuana consumption among Colorado adults ages 35 to 64 (5.6% in 2017 to 8.1% in 2019) and ages 65 years and older (2.2% in 2017 to 3.8% in 2019). Since retail marijuana became available in Colorado in 2014, there have been significant increases in daily or near daily marijuana consumption among adults ages 26-34 years (9.9% in 2014 to 15.7% in 2019), 34-64 years (4.7% in 2014 to 8.1% in 2019). Since 2015, there has been a significant increase in daily or near daily marijuana consumption among older adults ages 65+ years (1.9% in 2015 to 3.8% in 2019). Daily or near daily use/consumption has remained stable among young adults ages 18-25 years (13.3% in 2015 to 14.1% in 2019) in Colorado since 2015.

Daily or near daily marijuana use/consumption among Colorado adult males has significantly increased since our last report (10.3% in 2017 to 12.2% in 2019). Additionally, daily or near daily use/consumption has significantly increased among both adult males (7.4% in 2014 to 12.2% in 2019) and adult females (4.6% in 2014 to 6.2% in 2019) since retail marijuana became available in Colorado in 2014. Daily or near daily use/consumption has consistently remained significantly higher in males than females among Colorado adults since 2014. Daily or near daily marijuana use/consumption has also consistently remained significantly higher among Colorado adults who identify as gay, lesbian, bisexual (18.1% in 2019).

Driving after recent marijuana use/consumption remains stable among Colorado adults but has increased overall since retail marijuana commercialization in 2014

In 2019, 3.5% of Colorado adults reported driving after recent marijuana use/consumption. Since our last report there have been no significant changes (3.0% in 2017 to 3.5% in 2019; ***Figure 4***). Since retail marijuana became available in 2014, there has been a significant increase in driving after recent marijuana use/consumption among Colorado adults from 2.5% to 3.5%.

Among adult marijuana consumers in Colorado, 18.6% reported driving a vehicle after recent marijuana use/consumption in 2019. This trend has consistently remained stable, with no significant

change since our last report (19.7% in 2017) and no significant change since retail marijuana became available (18.8% in 2014).

Nearly half of adult marijuana users/consumers in Colorado use/consume daily or near daily and use multiple methods to consume

Nearly half (48.2%) of Colorado adult marijuana users/consumers used or consumed marijuana daily or near daily in 2019 (***Figure 5***). Daily or near daily marijuana use/consumption consistently remains significantly higher than weekly (31.6%) or monthly (20.2%) use/consumption among adult marijuana users/consumers in 2019. From 2018 to 2019, there was a significant increase in weekly marijuana use/consumption among adult marijuana users/consumers in Colorado (26.2% in 2018 to 31.6% in 2019). Daily or near daily use has remained stable since 2014 among Colorado adult marijuana users/consumers.

Half (51.0%) of Colorado adult marijuana users/consumers also reported using multiple methods to consume marijuana in 2019. This trend was first seen in 2017 and remains both stable and significantly higher compared to adult users/consumers who used a single method to use/consume.

More Colorado adults think daily marijuana use/consumption poses little to no harm

From 2017 to 2019, there was a significant increase in Colorado adults that think daily marijuana use/consumption has slight or no risk of harm (46.2% in 2017 to 52.3% in 2019; ***Figure 6***) and a significant decrease in adults that think daily use/consumption has a moderate or great risk of harm (53.8% in 2017 to 47.7% in 2019).

Since 2017, there have been no significant changes among Colorado adult marijuana users'/consumers' thinking about risk or harm of daily marijuana use/consumption. Prevalence remained stable in 2019 among adult marijuana users/consumers who thought there was moderate or great risk (16.6% in 2017 to 17.6% in 2019) and among those who thought there was slight or no risk (83.4% in 2017 to 82.4% in 2019).

Trends in adolescent marijuana use in Colorado

Marijuana use remains stable among Colorado adolescents since 2005

Since our last report, there have been no significant changes in past 30-day marijuana use among middle school students (5.2% in both 2017 and 2019) or high school students (19.4% in 2017 to 20.6% in 2019) in Colorado (***Figure 7***). There was also no significant change in reported ever use of marijuana among Colorado middle school students (8.6% in 2017 to 9.9% in 2019; ***Figure 8***) and high school students (35.2% in 2017 to 35.9% in 2019). Since 2015, past 30-day marijuana use among high school

students remained stable and not significantly different in Colorado (21.2% in 2015 to 20.6% in 2019) compared to the U.S. estimate (21.7% in both 2015 and 2019). Past 30-day marijuana use has remained stable among Colorado high school students since 2005 and among Colorado middle school students since 2011.

Driving after recent marijuana use increased among high school students

Since our last report, driving a vehicle after recently using marijuana significantly increased from 9.0% in 2017 to 11.2% in 2019 among Colorado high school students that drove in the past 30 days (***Figure 9***). In 2019, driving after recent marijuana use (11.2%) remained significantly higher than driving after alcohol use (5.9%). Also, in 2019, 19.1% of Colorado high school students were passengers in a vehicle with a driver who recently used marijuana, a stable trend since 2013. A higher proportion of high school students were passengers in vehicles with drivers who had recently used marijuana compared to those who rode in a car with a driver who recently used alcohol (19.1% vs. 16.0%) in 2019.

Smoking marijuana decreased as dabbing increased among Colorado high school students

Since our last report, there were significant increases in dabbing marijuana (6.9% in 2017 to 10.2% in 2019; ***Figure 10***) and vaporizing marijuana (4.0% in 2017 to 6.8% in 2019) among Colorado high school students. Smoking marijuana remained the most prevalent method of use but decreased from 17.6% in 2017 to 15.3% in 2019 among high school students. The 2019 prevalence of eating (7.0%) and using in other ways (1.6%) remained stable. Significant changes were also seen in usual method of marijuana use among Colorado high school students (***Figure 11***); dabbing increased (1.4% in 2017 to 3.9% in 2019) and vaping increased (0.7% in 2017 to 2.0% in 2019), while smoking decreased (14.4% in 2017 to 10.6% in 2019). Smoking marijuana as one of multiple possible methods of use or as the usual method of use has remained significantly most prevalent of all methods among Colorado high school students since 2013. In 2019, 7.4% of high school students reported using marijuana only one or two times in the past 30 days. This trend remained stable and significantly more prevalent than using three times or more since 2013.

Among high school students in Colorado who reported current (past 30 days) marijuana use, dabbing significantly increased from 20.3% in 2017 to 52.0% in 2019 (***Figure 12***). Smoking marijuana remained the most prevalent method of use among current high school users but significantly decreased from 88.4% in 2017 to 77.9% in 2019. The prevalence of eating, vaporizing, and other methods of marijuana use remained stable among current users. In 2019, smoking marijuana remained the most reported usual method of use at 55.9% in 2019, however, that is a significant decreased compared to 77.8% reported in 2017 (***Figure 13***). However, dabbing as the usual method of use among current high school

users significantly increased from 7.6% in 2017 to 20.4% in 2019. Among high school students who report current use, smoking marijuana as one of possibly multiple methods of use or as the usual method of use has remained significantly more prevalent than all other methods since 2013. Among current marijuana users in high school, 58.2% used nine times or less in the past 30 days, with 35.7% using only one or two times in 2019. However, 41.7% of current marijuana users in high school reported using 10 or more times in the past 30 days in 2019.

Adolescent marijuana use remains significantly lower than alcohol use and e-cigarette use

In 2019, use of marijuana by high school students in the past 30 days (20.6%) remained significantly lower than past 30-day use of alcohol (29.6%) and electronic cigarette (nicotine containing) use (25.9%) but was significantly higher than past 30-day use of cigarettes (5.7%) and illicit prescription drugs (6.9%). This trend has remained stable among all these substances since 2015 (***Figure 14***).

Marijuana use remained highest among LGBT adolescents; stable among all other demographics

In 2019, past 30-day marijuana use remained higher in high school students who identify as gay, lesbian, or bisexual (30.9%) compared to those who identify as heterosexual (18.2%). However, from 2013 to 2019, past 30-day marijuana use significantly decreased from 39.7% to 30.9% among high school students who identify as gay, lesbian, or bisexual. In 2019, significantly more (33.3%) high school students who identify as transgender used marijuana in the past 30 days compared to 29.7% among students who identify as cisgender.

Past 30-day marijuana use among high school males (21.0% in 2019) and females (20.2% in 2019) remains stable and not significantly different since 2013. In 2019, there was no significant difference in past 30-day marijuana use among middle school males (5.1%) and females (5.4%). Since 2013, past 30-day marijuana use rates remain stable among both middle school males and females.

Since 2013, past 30-day marijuana use has remained stable among all high school student race/ethnicity groups. In 2019, past 30-day use was not significantly different among high school students of American Indian/Alaskan Native, Black/African American, Hispanic/Latino, Native Hawaiian/Other Pacific Islander, and Multiple race/ethnicity groups, but all were significantly higher compared to past 30-day use among white high school students. Past 30-day use was lowest among Asian high school students in 2019.

Past 30-day marijuana use remains significantly higher in 2019 among high school students in grades 11 and 12 compared to those in grades nine or 10. Since 2013, there have been no significant differences from year to year in past 30-day marijuana use by grade among high school students.

Since 2017, middle school student past 30-day use remained significantly higher among eighth grade students (7.7% in 2019) compared to sixth grade students (2.4% in 2019). Nearly three quarters (72.8%) of high school seniors in 2019 who reported ever using marijuana also reported trying marijuana for the first time between the ages of 13 and 16 years old (48.1% between 15 and 16 years and 24.7% between 13 and 14 years).

Marijuana in Colorado homes with children

Majority of marijuana is stored safely in homes where both marijuana and children are present

Data combined from years 2018 and 2019 from the Child Health Survey estimated 14.0% of Colorado homes with children reported marijuana being present in or around the home. Among the 14.0% of homes, the majority (89.6%) reported storing marijuana safely by keeping it in child-resistant packaging, out of reach, or in a locked location (***Figure 15***).

Continued concern about secondhand exposure among children

Data combined from 2018 and 2019 show 92.0% of homes in Colorado with children between the ages of 1 and 14 years old, did not report adult marijuana use/consumption in the home. However, among the 8.0% of Colorado adults who reported using/consuming marijuana inside the home, 71.4% smoked, vaporized, and/or dabbed marijuana and 49.2% used marijuana products that were eaten in food or consumed in beverages (***Figure 16***). These estimates are inclusive of one or more methods of marijuana use/consumption in the home.

Trends in marijuana use/consumption during pregnancy and breastfeeding in Colorado

Marijuana use/consumption during pregnancy and breastfeeding remains stable

In 2018, marijuana use/consumption during pregnancy was about half the prevalence (8.2%) it was before pregnancy (16.5%) and has remained stable since 2016 (***Figure 17***). Since our last report, marijuana consumption among postpartum-currently breastfeeding moms in Colorado has remained stable, from 3.5% in 2017 to 4.9% in 2018. Marijuana consumption among women postpartum (not currently breastfeeding at the time survey was completed) was also stable at 7.9% in 2018. Since retail marijuana became available in 2014, there has been no significant change in marijuana use/consumption during pregnancy in Colorado (5.7% in 2014 to 8.2% in 2018).

Alcohol and cigarette consumption more prevalent than marijuana consumption during pregnancy

In 2018 alcohol consumption (14.4%) remained the most prevalent substance consumed during pregnancy and significantly higher than marijuana consumption (8.2%), which was as prevalent as cigarette consumption (7.1%) and less prevalent than electronic cigarette consumption (1.2%; ***Figure 18***). Data combined from 2014 to 2018 comparing single substance consumption to multiple substance consumption over time among moms when they were in their last three months of pregnancy, alcohol-only (13.3%) and cigarette-only consumption (4.9%) were the most prevalent and significantly higher than marijuana-only consumption (1.2%). Marijuana and cigarette consumption (0.75%) was the most prevalent combination of multiple substance use/consumption among other alcohol, cigarette, and marijuana combinations among moms during the last three months of pregnancy in Colorado.

Marijuana consumption during pregnancy remains most prevalent among younger moms and those with unintended pregnancies

Data combined from 2016-2018 showed marijuana consumption during pregnancy was significantly higher in younger moms ages 15-19 years old (15.9%) and ages 20-24 (12.4%) compared to moms ages 25-34 (6.5%) and 35 years and older (5.3%). Marijuana consumption during pregnancy remained significantly higher among moms with less than 12 years of education (12.8%) and moms with 12 years of education (12.1%) compared to moms with more than 12 years of education (5.6%). Additionally, marijuana consumption during pregnancy remained significantly higher among women who did not intend to become pregnant (12.8%) compared to women who intended to become pregnant (4.5%). There were no significant differences in marijuana consumption during pregnancy by race/ethnicity.

Discussion

Marijuana use/consumption in Colorado is more complex than any one population-based survey can capture. Currently available data cannot answer all the questions we have about whether or not marijuana use/consumption patterns are changing as a result of legalization. Furthermore, it is difficult to predict if documented trends will persist in years to come. The data presented here provide important insights into marijuana use/consumption in adults, as well as the disparities among vulnerable populations such as pregnant women and youth.

Encouraging trends

- Since the 2016 report we have not identified any **new** disparities in adult marijuana use/consumption by age, gender, race, ethnicity, or sexual orientation since legalization.
- Daily or near daily marijuana use/consumption among adults is much lower than binge drinking and daily or near daily tobacco use/consumption.

- For adolescents, estimated prevalence of past 30-day marijuana use and frequencies of marijuana use have not changed since legalization.
- Past 30-day marijuana use among Colorado adolescents is similar to the national average.
- Among adolescents, past 30-day marijuana use continues to be lower than past 30-day alcohol use and electronic vapor products with nicotine use.
- The majority of homes in Colorado with children do not have marijuana present or being used/consumed inside the home. Among homes that do have marijuana present, the majority of homes are storing marijuana safely.

Trends to continue monitoring

- Daily or near daily marijuana consumption is increasing among older Colorado adults.
- The gap is closing in the prevalence of women who discontinue marijuana use/consumption postpartum.
- Past 30-day marijuana use/consumption (19.0%) and daily or near daily (9.1%) use/consumption among adults in Colorado has increased in 2019.
- Past 30-day marijuana use/consumption among adults in Colorado is higher than the national average. In Colorado, 28.8% of adults ages 18-25 reported use/consumption in the past 30 days and 14.1% reported daily or near daily marijuana use/consumption.
- Since 2017, significant increases in consumption were observed among older Colorado adults ages 35 to 64 (12.8% in 2017 to 17.3% in 2019) and ages 65 years and older (5.6% in 2017 to 9.3% in 2019).
- Since retail marijuana became available in Colorado in 2014, there have been significant increases in daily or near daily marijuana consumption among adults ages 26+.
- In 2019, smoking marijuana remained the most prevalent method of marijuana use/consumption among Colorado adults (14.4%), followed by eating/drinking (8.1%), vaporizing (6.1%), dabbing (3.7%), and other methods (2.2%).
- There continues to be disparities in marijuana use/consumption based on age, sex, race/ethnicity, and sexual orientation for both adults and adolescents, signifying health inequities in certain populations in Colorado.
- Since 2014, use/consumption among adults and use among adolescents has remained consistently higher in the southwest region of the state. In 2019, marijuana use/consumption among Colorado adults was highest in the southwest (19.8%) and northwest (19.2%) regions of the state.
- In 2019, more Colorado adults think daily marijuana use/consumption has slight or no risk of harm and less Colorado adults think daily use/consumption has a moderate or great risk of harm.

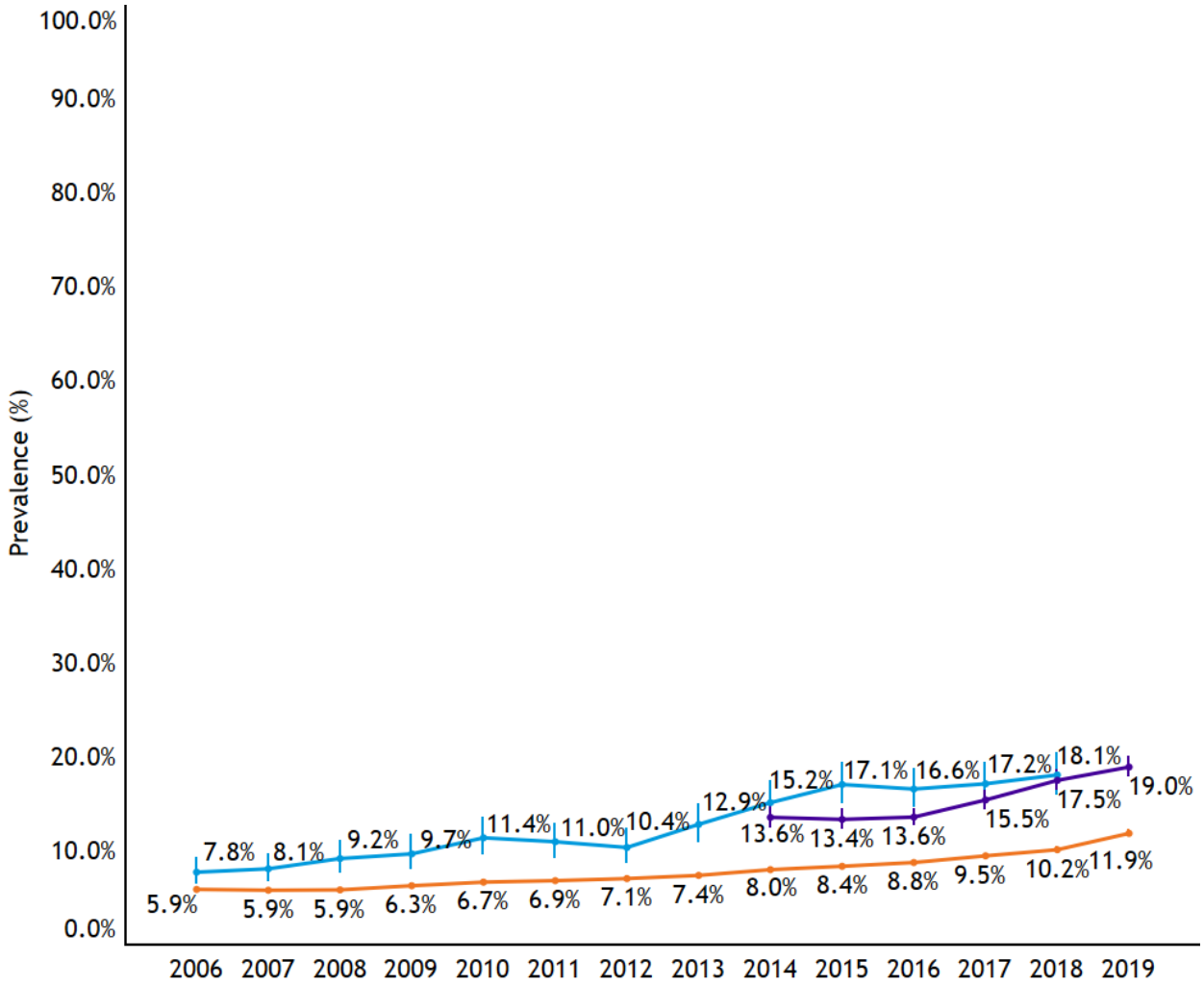
- Past 30-day marijuana use among middle school and high school students has remained stable.
- In 2019, more high school students drove a vehicle after recently using marijuana than in 2017.
- Colorado high school students dabbed (10.2%) and vaporized (6.8%) marijuana more in 2019 than previous years, however, smoking marijuana remained the most prevalent method of use/consumption.
- In 2019, 10.4% of homes with children in Colorado may not be storing marijuana products safely, which increases the risk of accidental ingestion of marijuana products by others, in particular children.
- Colorado children may be at risk of exposure to secondhand marijuana smoke in the home.
- In 2018, 8.2% of pregnant women used/consumed marijuana during pregnancy. This percentage is higher among those with unintended pregnancies, younger mothers, and mothers with 12 years or less of education.

Recommendations and future directions

1. Continue assessing prevalence of marijuana use/consumption via large Colorado-based surveys including the Pregnancy Risk Assessment Monitoring System, Healthy Kids Colorado Survey, Behavioral Risk Factor Surveillance System and the Child Health Survey. Data from surveys identify trends in use/consumption patterns that can be used to inform and target education and prevention strategies. Continued surveys using the same methodology can act as a feedback loop to ensure marijuana policies and education campaigns are effective.
2. Continue to develop, improve, and explore additional data sources to monitor marijuana use/consumption patterns.
3. Continue in-depth analyses of existing survey data to assess risk and protective factors for marijuana use/consumption, including changes in the perception of harm from marijuana use/consumption.
4. Continue collaboration with other state and national agencies to identify data that might add additional detail about use/consumption patterns in specific populations or geographic areas in the state.

Section 1 Figures

Figure 1: Annual prevalence of past 30-daymarijuana use/consumption among adults 18 years or older, Colorado and U.S. 2006-2019.



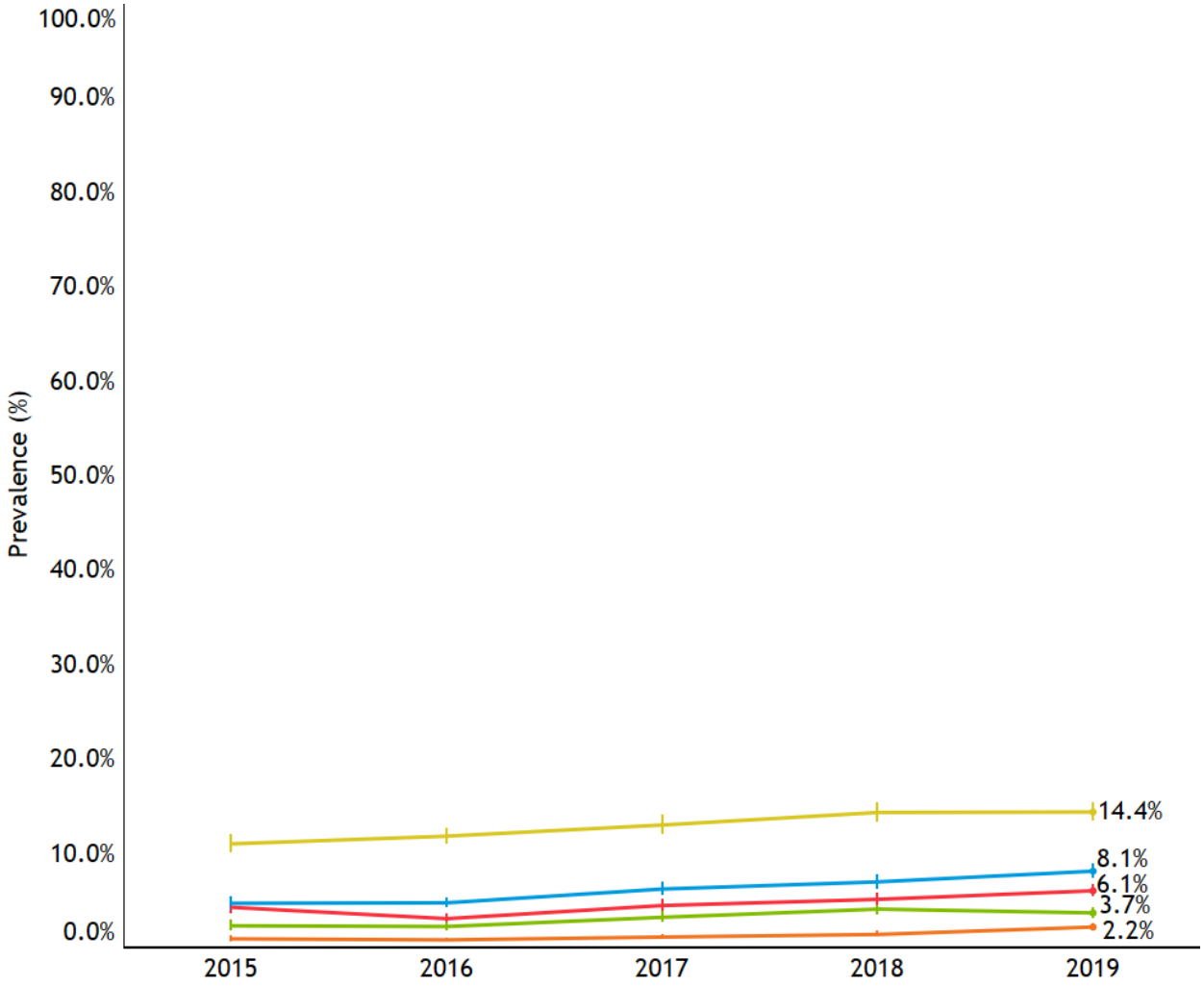
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey, National Survey of Drug Use and Health

Figure Notes:
95% Confidence Intervals indicated by bars

- BRFSS: Colorado Adults
- NSDUH: Colorado Adults
- NSDUH: U.S.

Figure 2: Annual prevalence of method of marijuana use/consumption among Colorado adults, Colorado 2015-2019



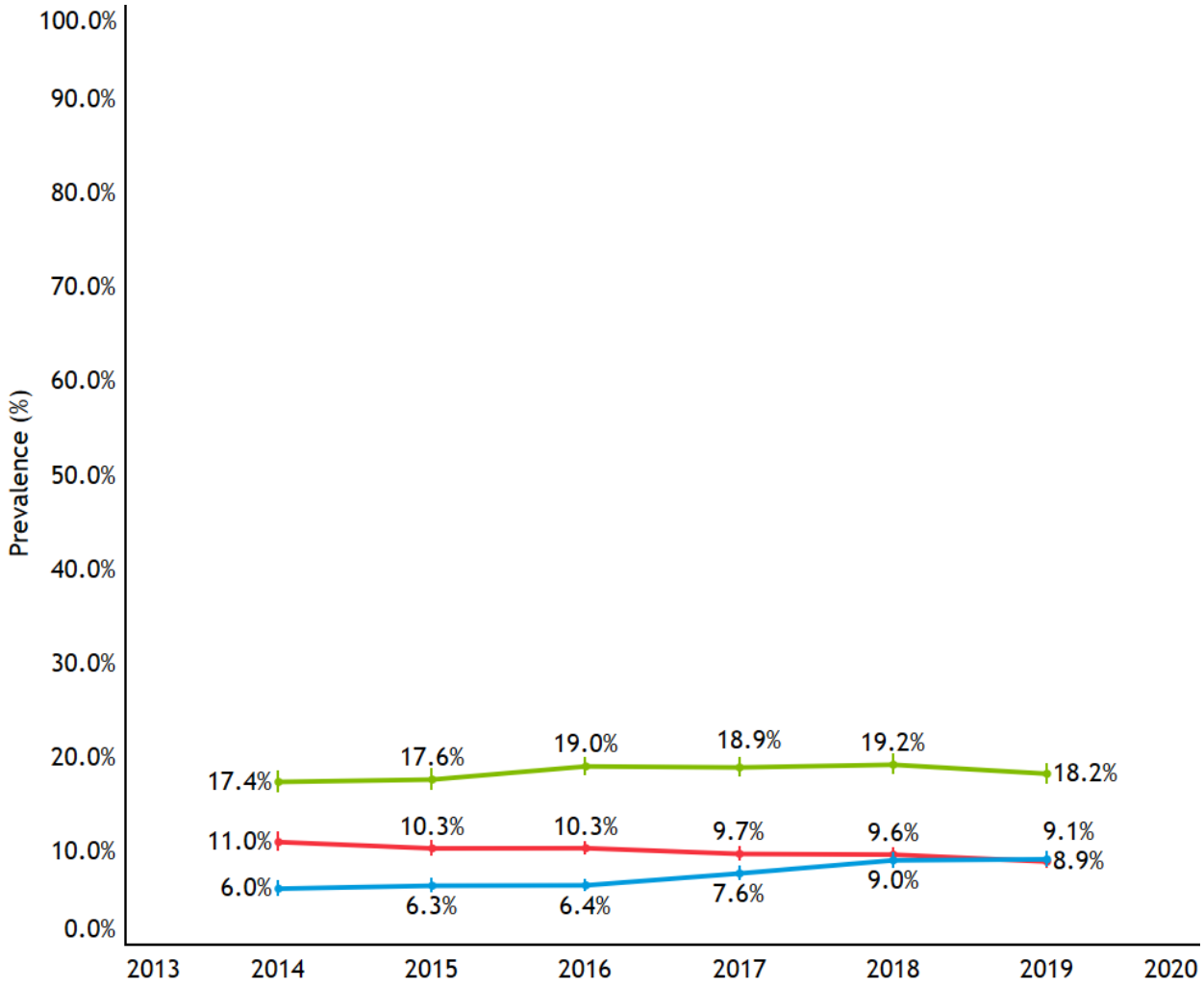
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Smoked
- Ate or drank
- Vaporized
- Dabbed
- Other method not listed

Figure 3: Annual prevalence of daily or near daily marijuana use/consumption compared to daily tobacco use and past 30-day binge drinking among Colorado adults, Colorado 2014-2019



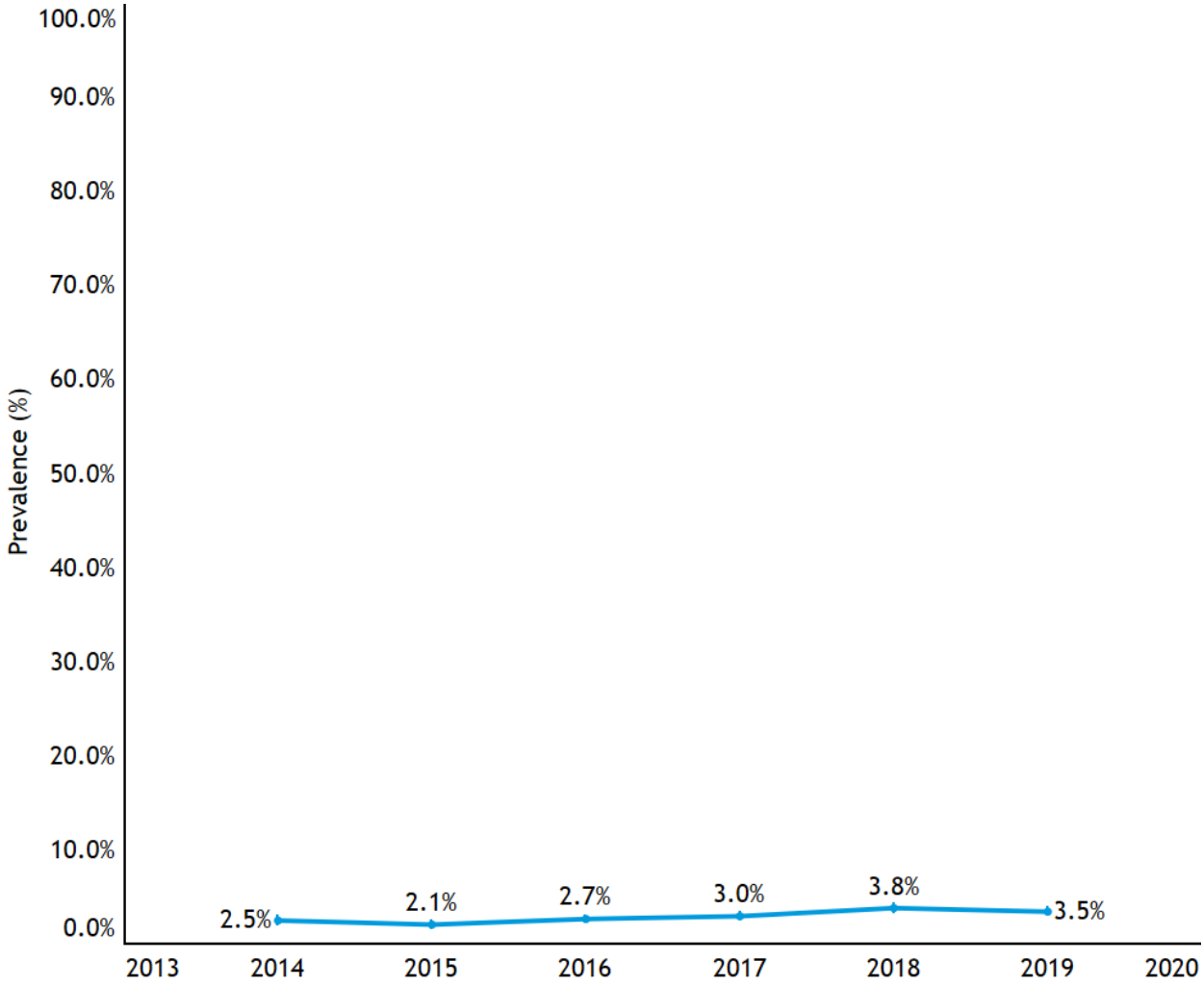
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Binge drank alcohol at least once in past 30 days
- Marijuana use daily/near daily
- Smoked cigarettes daily

Figure 4: Annual prevalence of driving after recent marijuana use/consumption among Colorado adults, Colorado 2014-2019



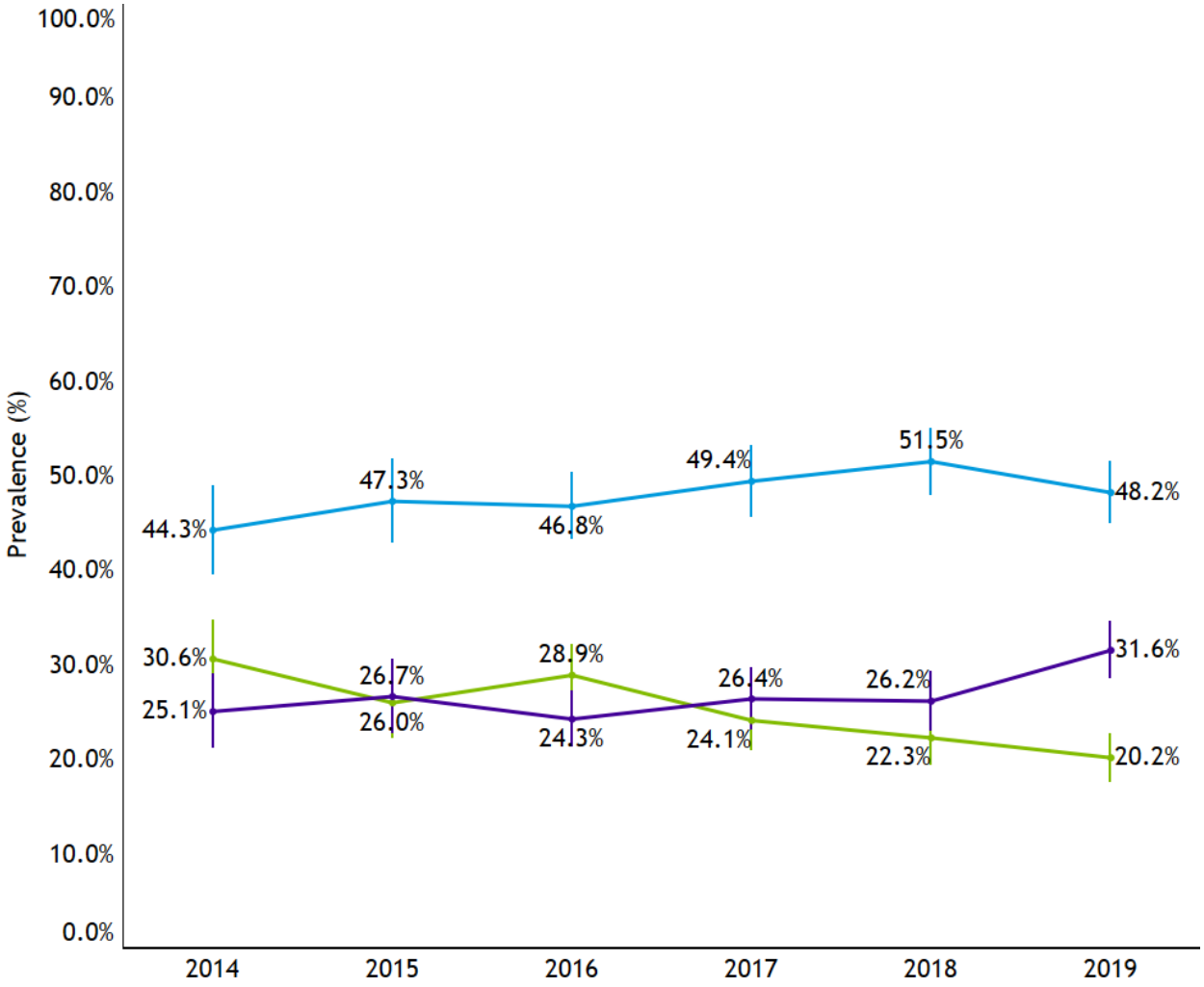
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey

Figure Notes:
95% Confidence Intervals indicated by bars

Drove after marijuana use

Figure 5: Annual prevalence of frequency of marijuana use/consumption in the past 30 days among adult marijuana consumers, Colorado 2014-2019



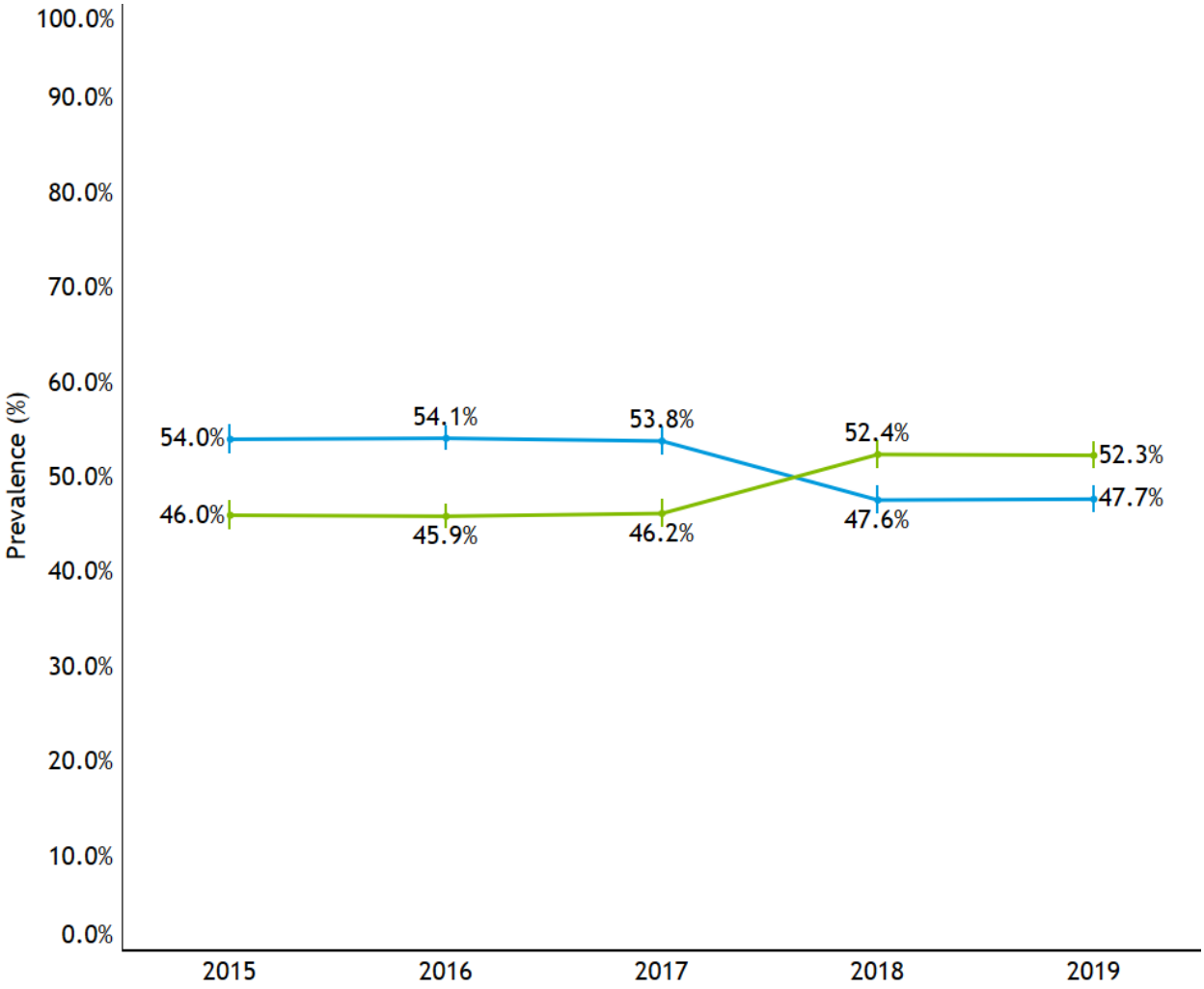
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Daily/near daily
- Weekly
- Monthly

Figure 6: Perceptions of risk of harm from daily or near daily marijuana among Colorado adults, Colorado 2015-2019



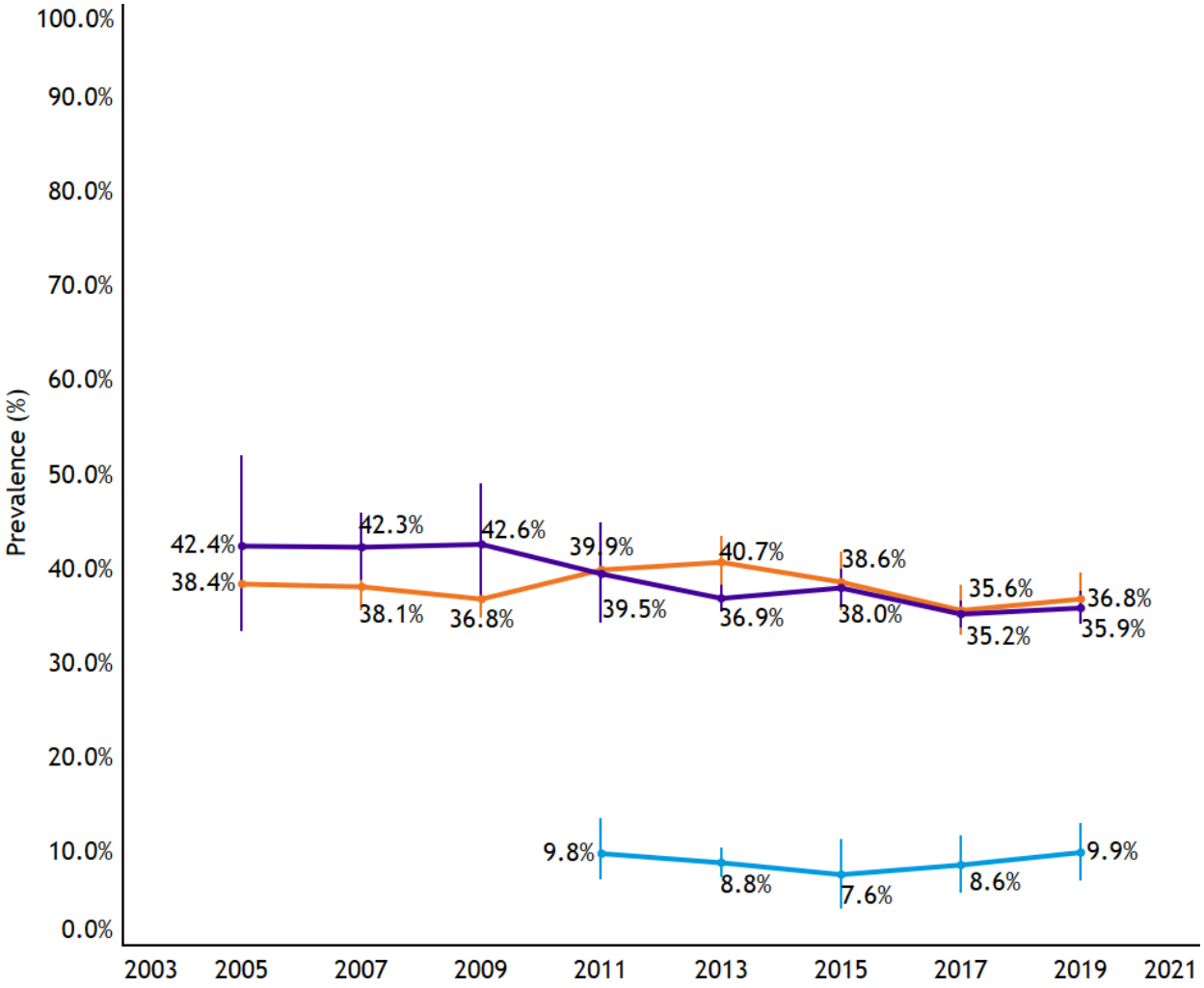
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Behavioral Risk Factor Surveillance Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- No or slight risk
- Moderate or great risk

Figure 7: Biennial prevalence of past 30-day marijuana use among high school and middle school students, Colorado and U.S. 2005-2019



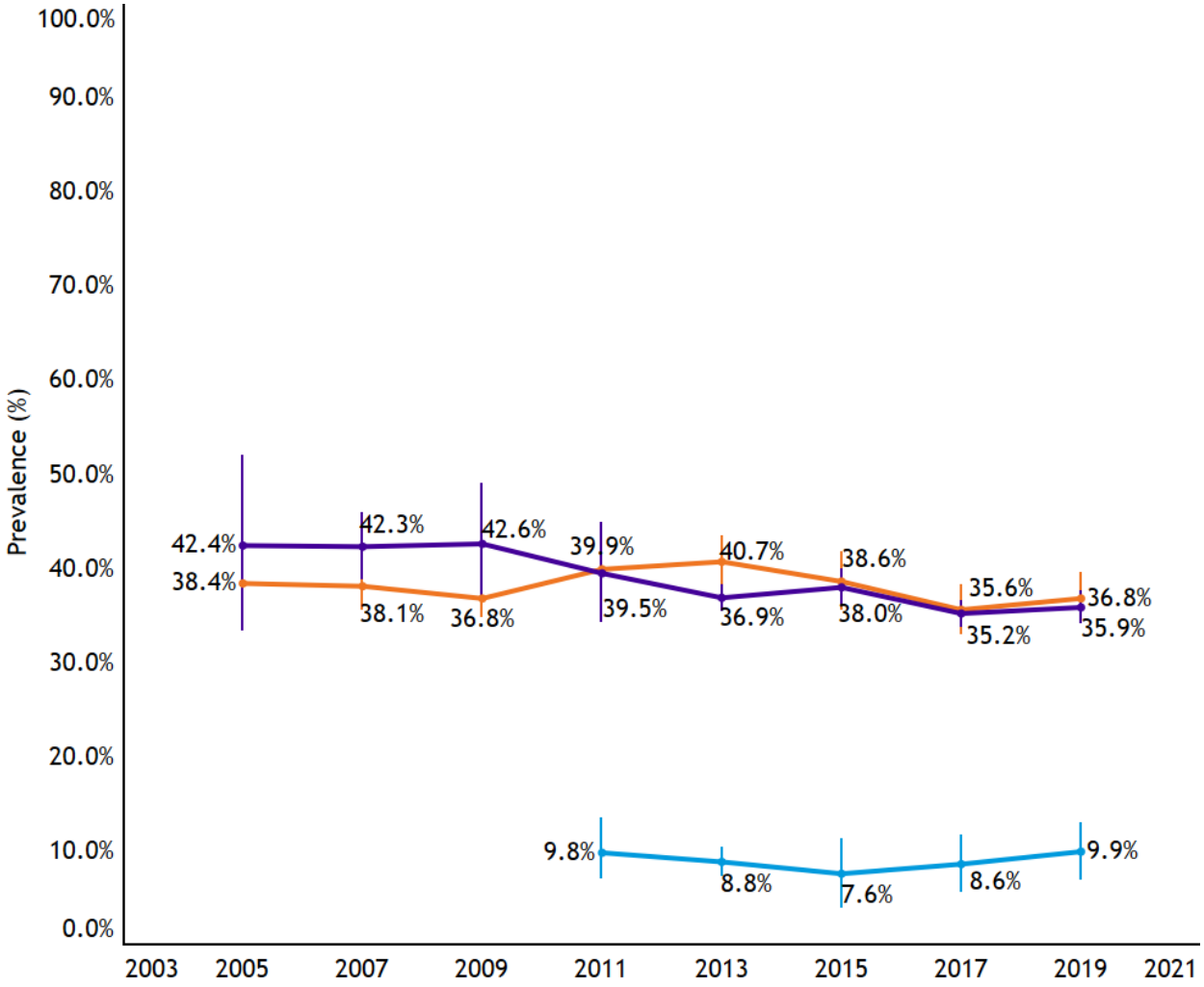
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Health Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Colorado high school students (HKCS/YRBS)
- Colorado middle school students (HKCS/YRBS)
- National high school students (YRBS)

Figure 8: Biennial prevalence of ever marijuana use among high school and middle school students, Colorado and U.S. 2005-2019



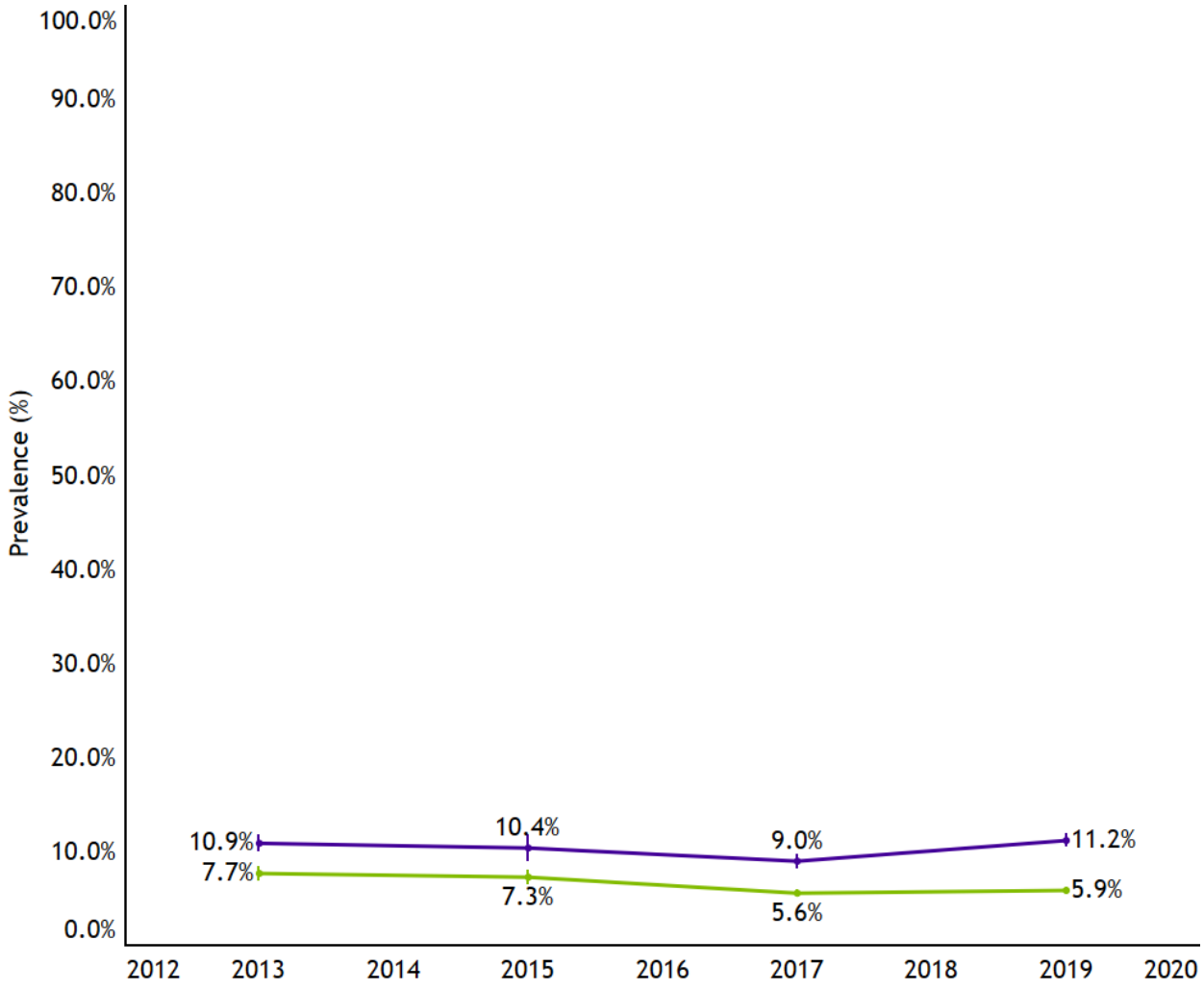
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Health Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Colorado high school students (HKCS/YRBS)
- Colorado middle school students (HKCS/YRBS)
- National high school students (YRBS)

Figure 9: Biennial prevalence of driving after recent marijuana use compared to alcohol use among high school students that drove in the past 30 days, Colorado 2013-2019



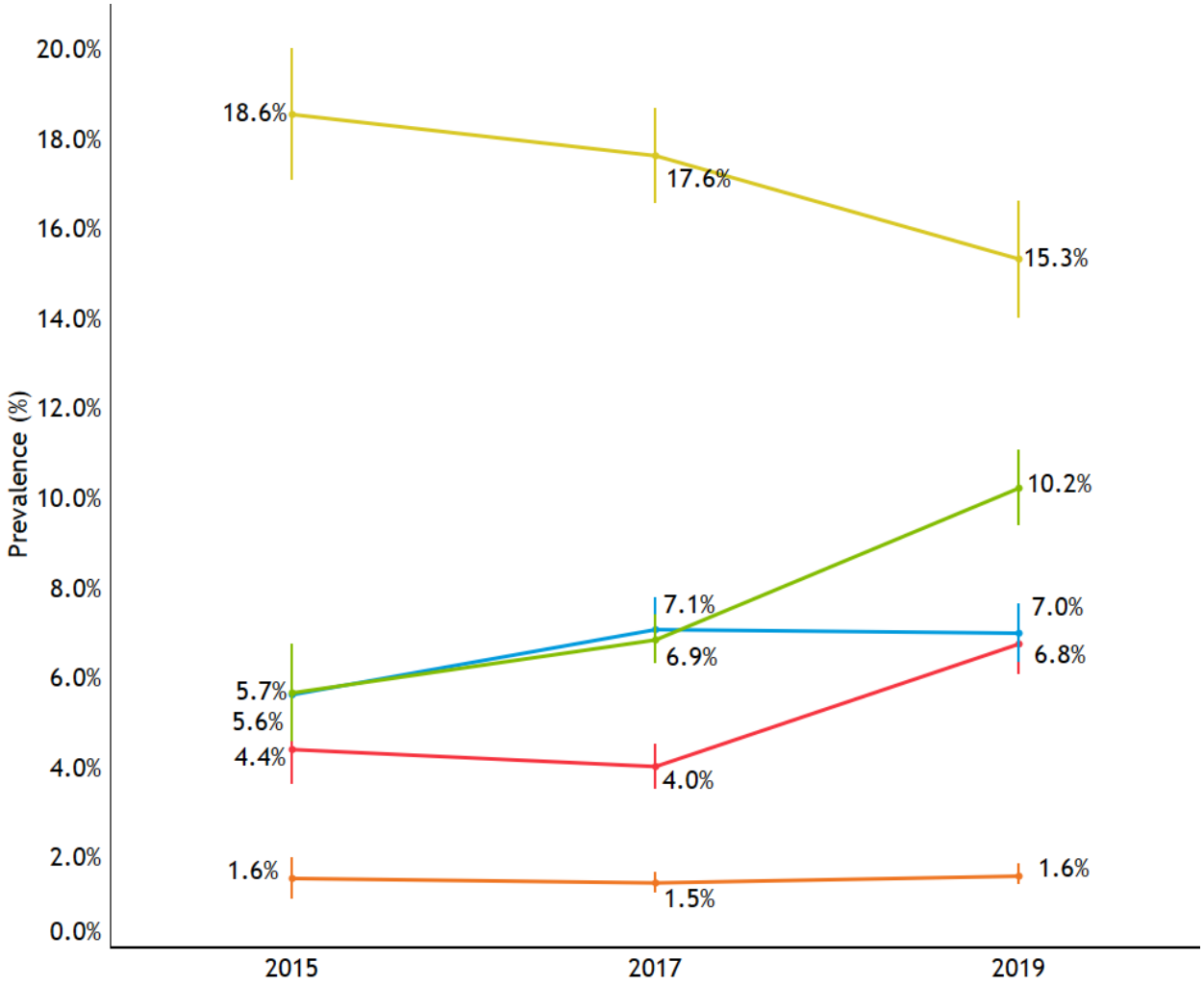
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Drove after alcohol use
- Drove after marijuana use

Figure 10: Biennial prevalence of method of marijuana use among high school students, Colorado 2015-2019



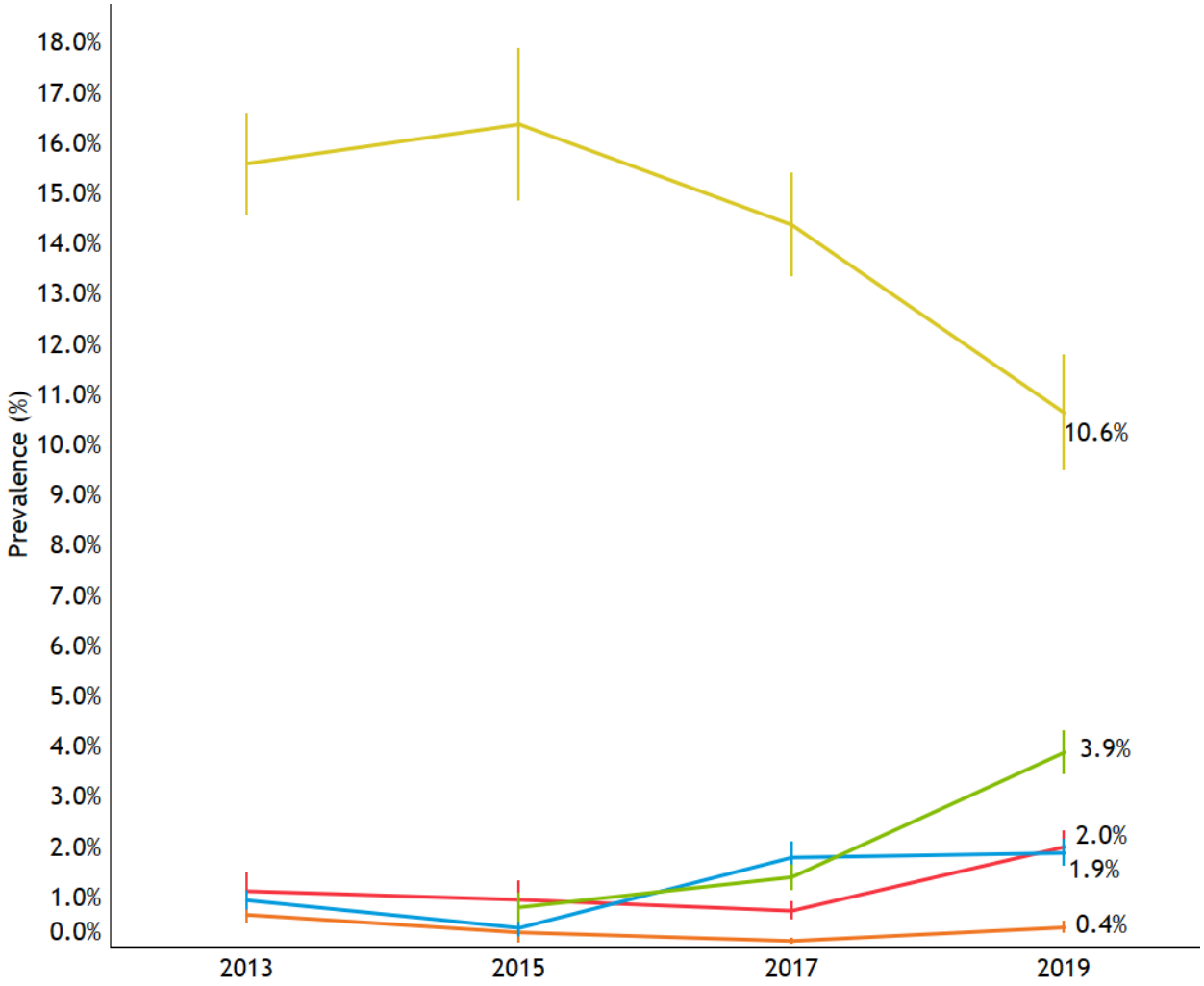
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Smoked
- Dabbed
- Ate
- Vaporized
- Used it in some other way

Figure 11: Biennial prevalence of usual method of marijuana use among high school students, Colorado 2011-2019



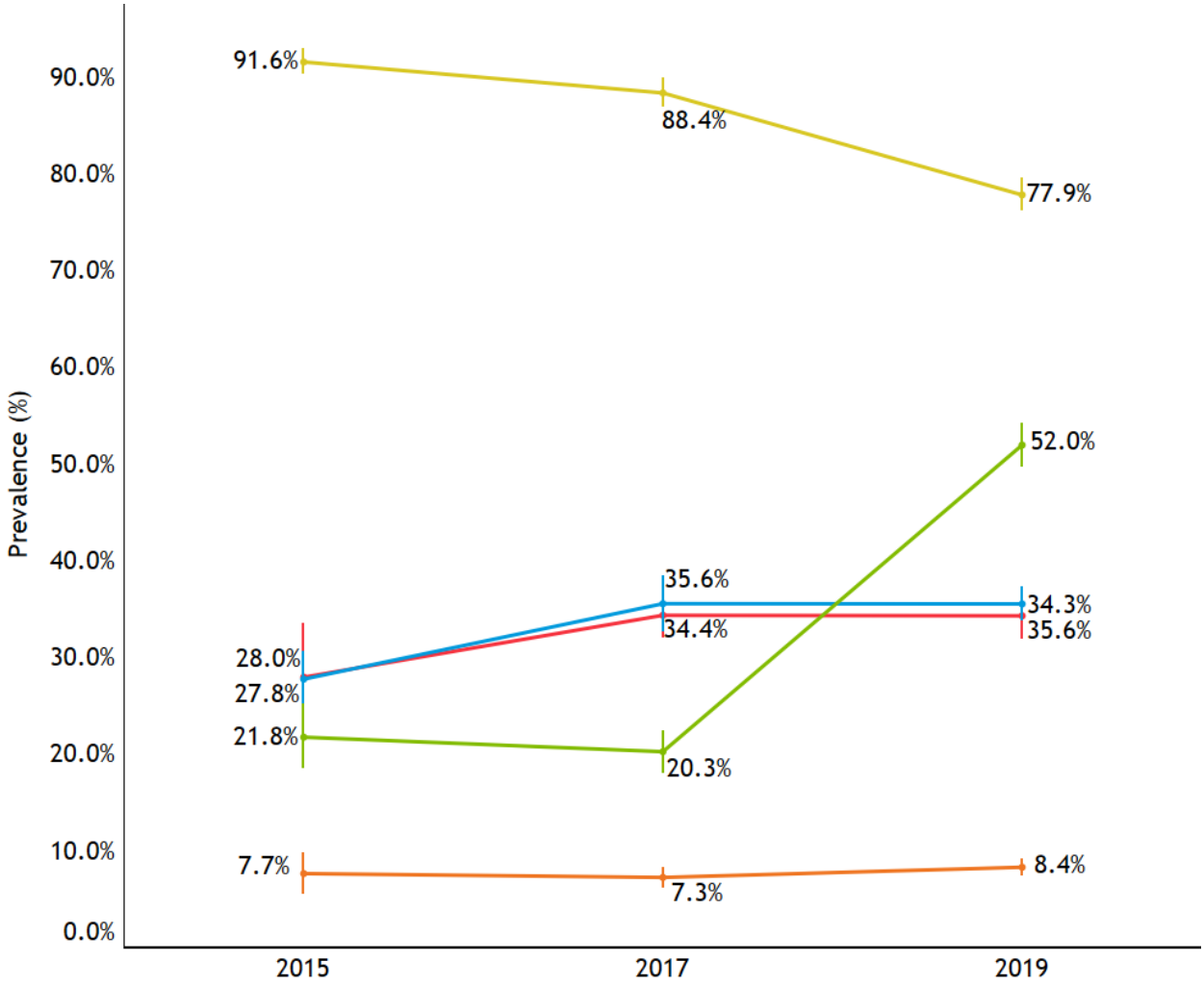
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Smoked
- Dabbed
- Ate
- Vaporized
- Used it in some other way

Figure 12: Biennial prevalence of method of marijuana use among high school students who reported past 30-day marijuana use, Colorado 2015-2019



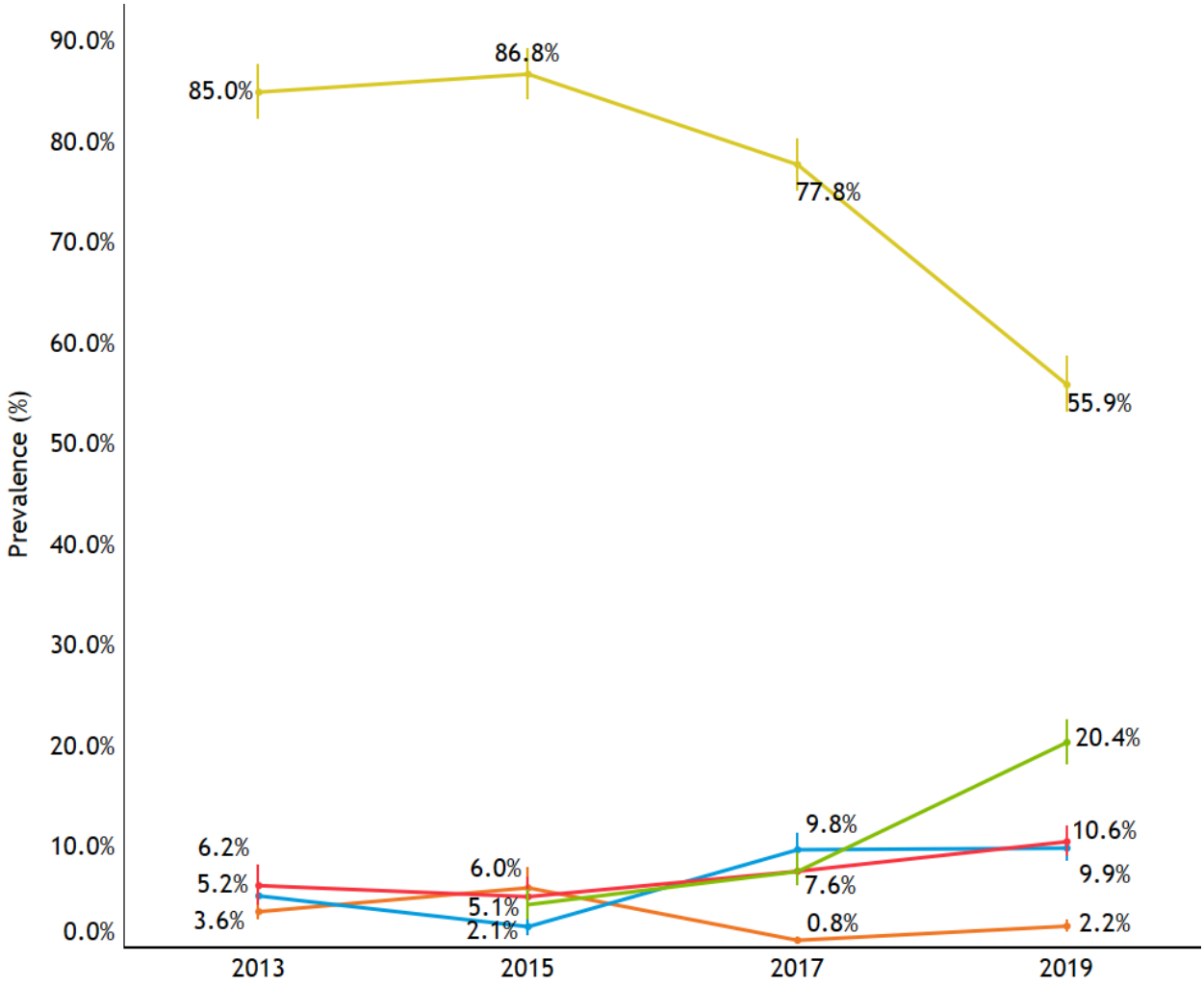
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Smoked
- Dabbed
- Ate
- Vaporized
- Used it in some other way

Figure 13: Biennial prevalence of usual method of marijuana use among high school students who reported past 30-daymarijuana use, Colorado 2013-2019



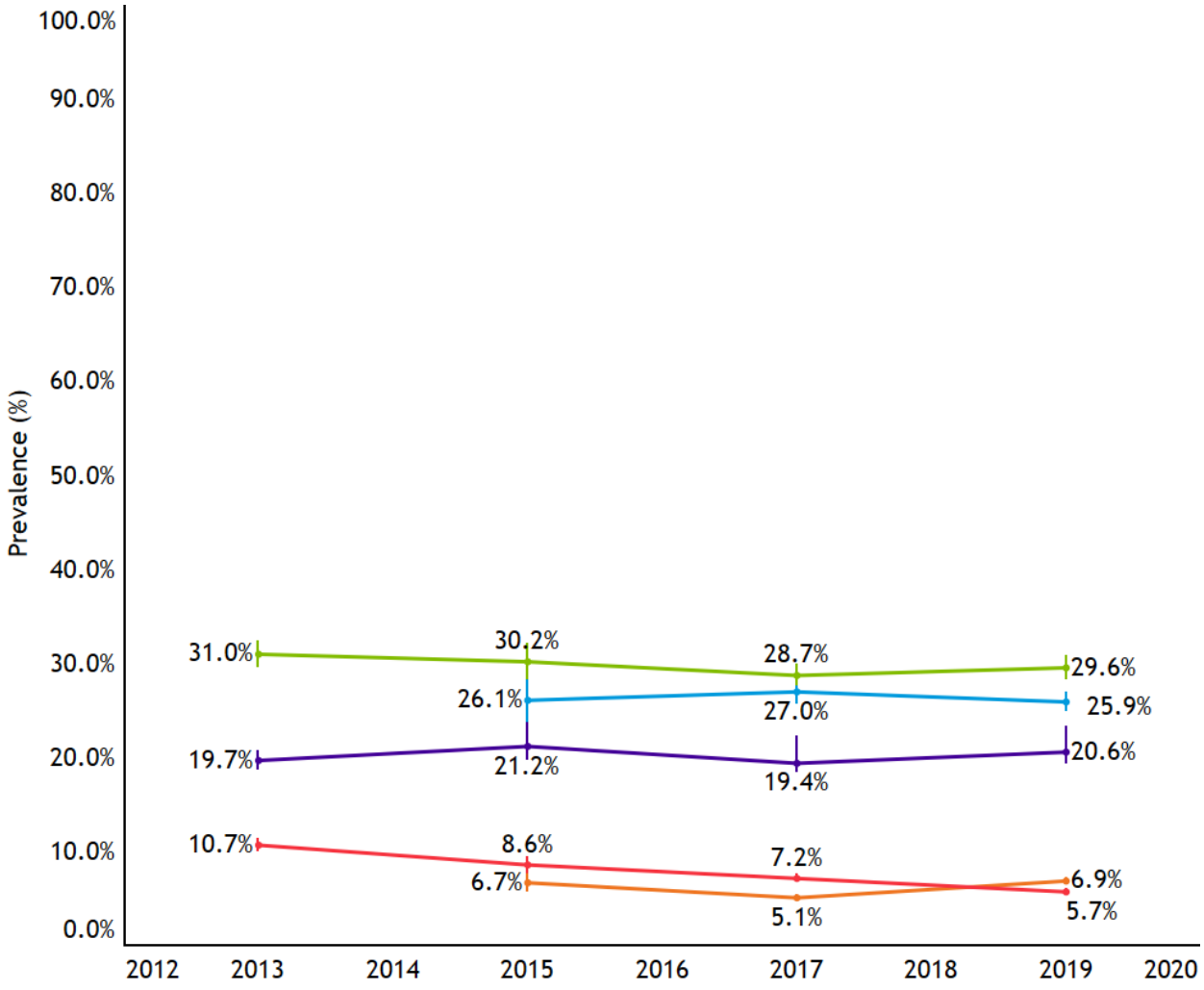
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Smoked
- Dabbed
- Vaporized
- Ate
- Used it in some other way

Figure 14: Biennial prevalence of past 30-daymarijuana use compared to past 30-dayalcohol, cigarette, electronic cigarette and illicit prescription drug use among high school students, Colorado 2013-2019



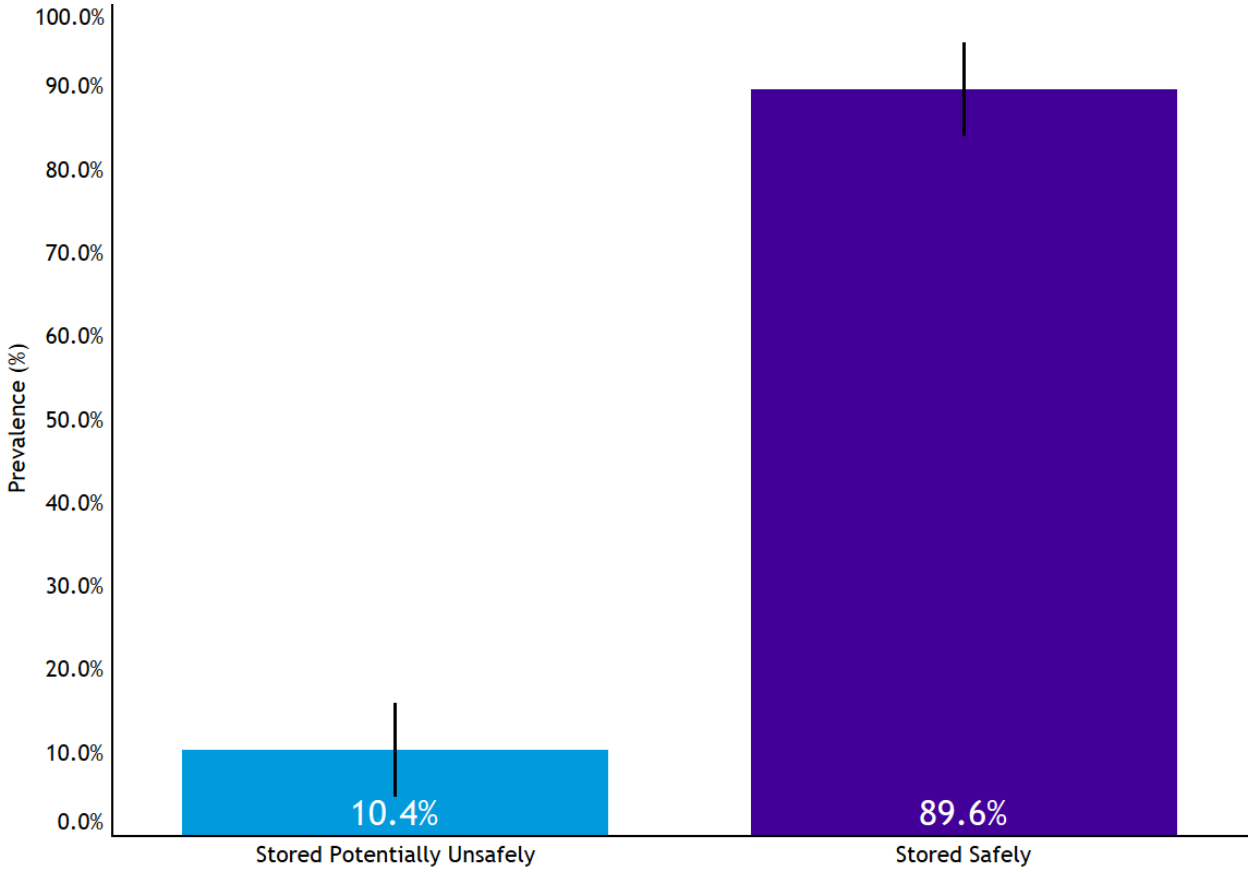
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Healthy Kids Colorado Survey

Figure Notes:
95% Confidence Intervals indicated by bars

- Alcohol
- Electronic cigarettes (nicotine)
- Marijuana
- Cigarettes
- Illicit perscription drugs

Figure 15: Safe storage of marijuana in homes* with children 1 to 14 years old, Colorado 2018-2019**

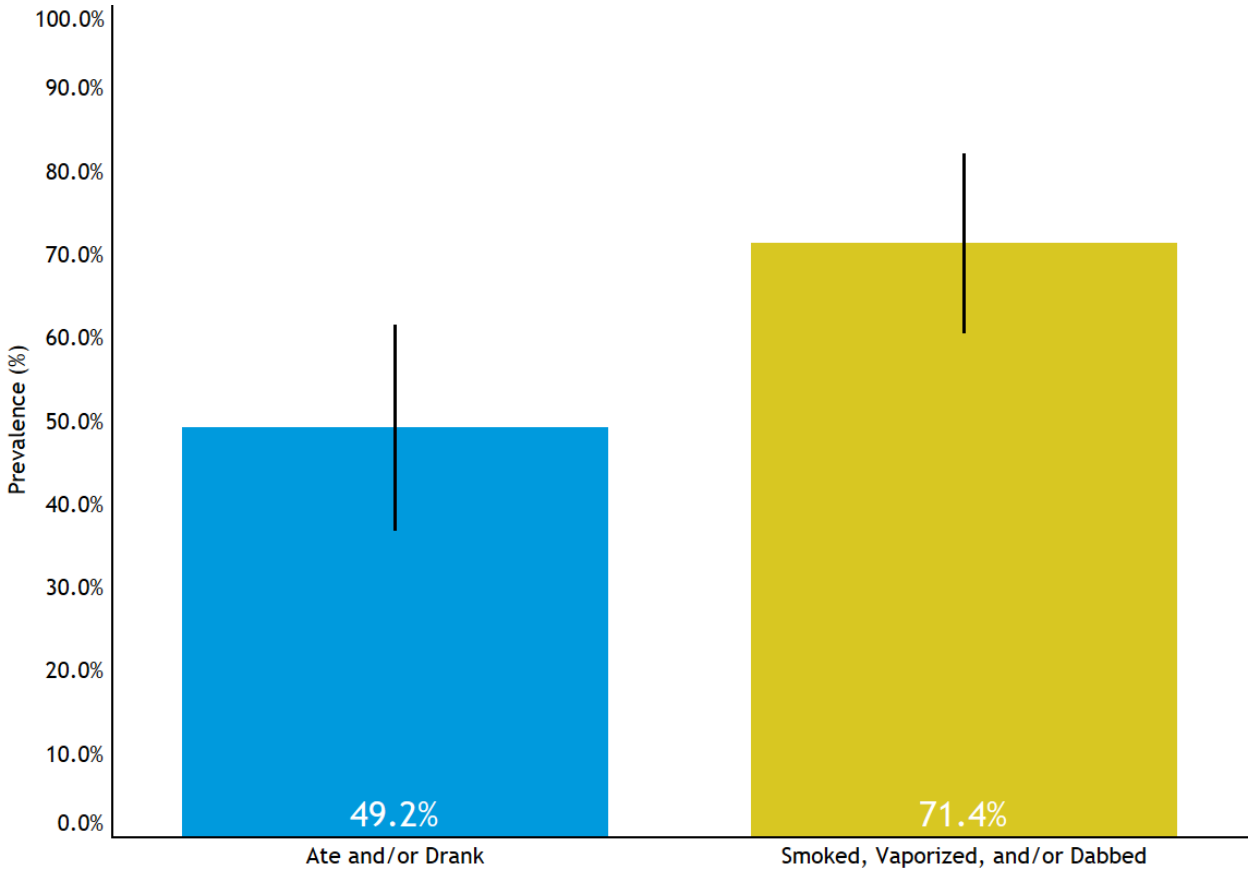


Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Child Health Survey

Figure Notes:
*Among 14.0% of homes that reported marijuana present in or around the home
**Combined years due to small sample size
95% Confidence Intervals indicated by bars

Figure 16: Methods of adult marijuana use/consumption in homes* with children age 1 to 14 years, Colorado 2018-2019**

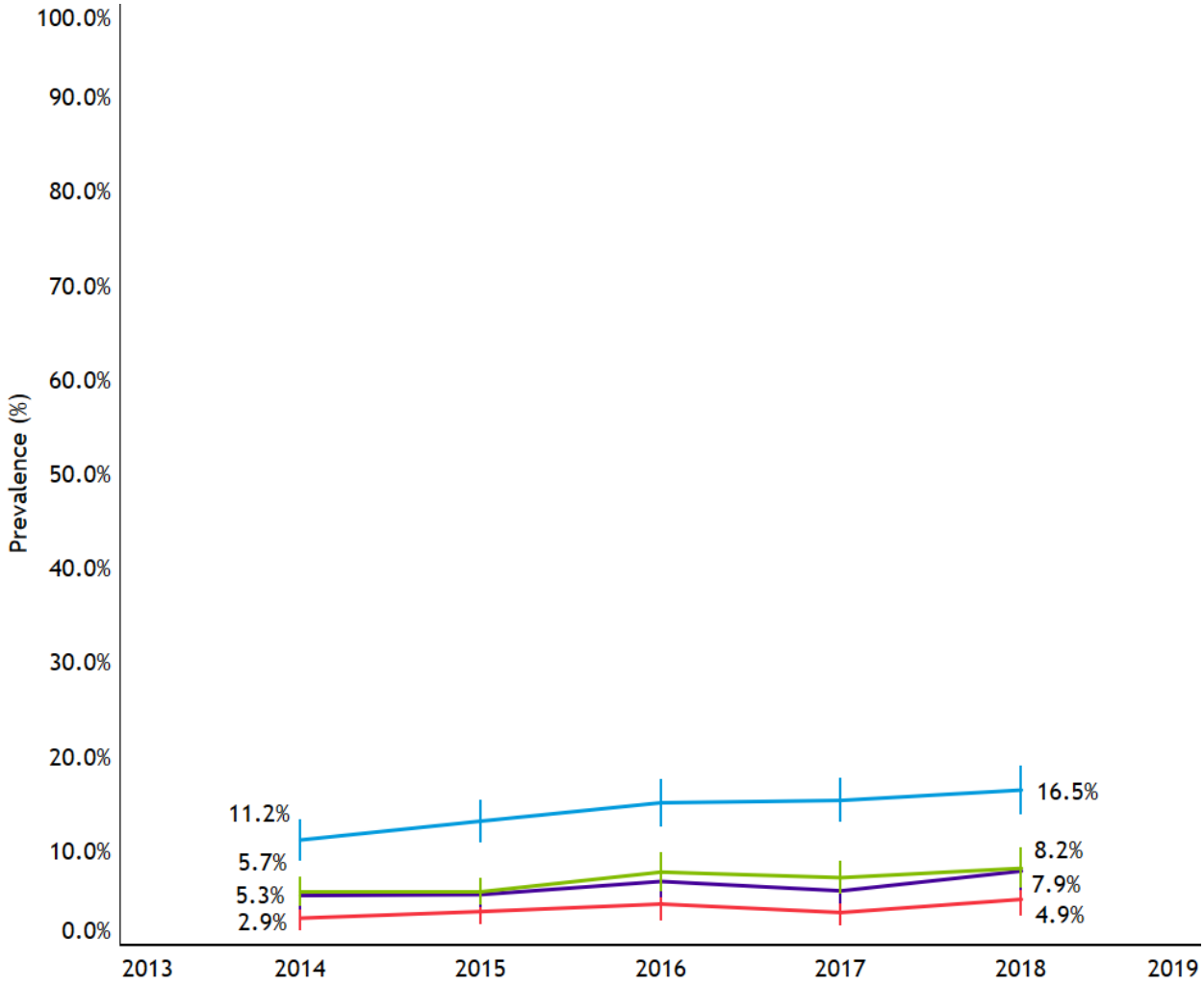


Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Child Health Survey

Figure Notes:
*Among 8.0% of homes that reported using marijuana inside the home
**Combined years due to small sample size
95% Confidence Intervals indicated by bars

Figure 17: Annual prevalence of marijuana use/consumption before*, during**, and after pregnancy***, Colorado 2014-2018



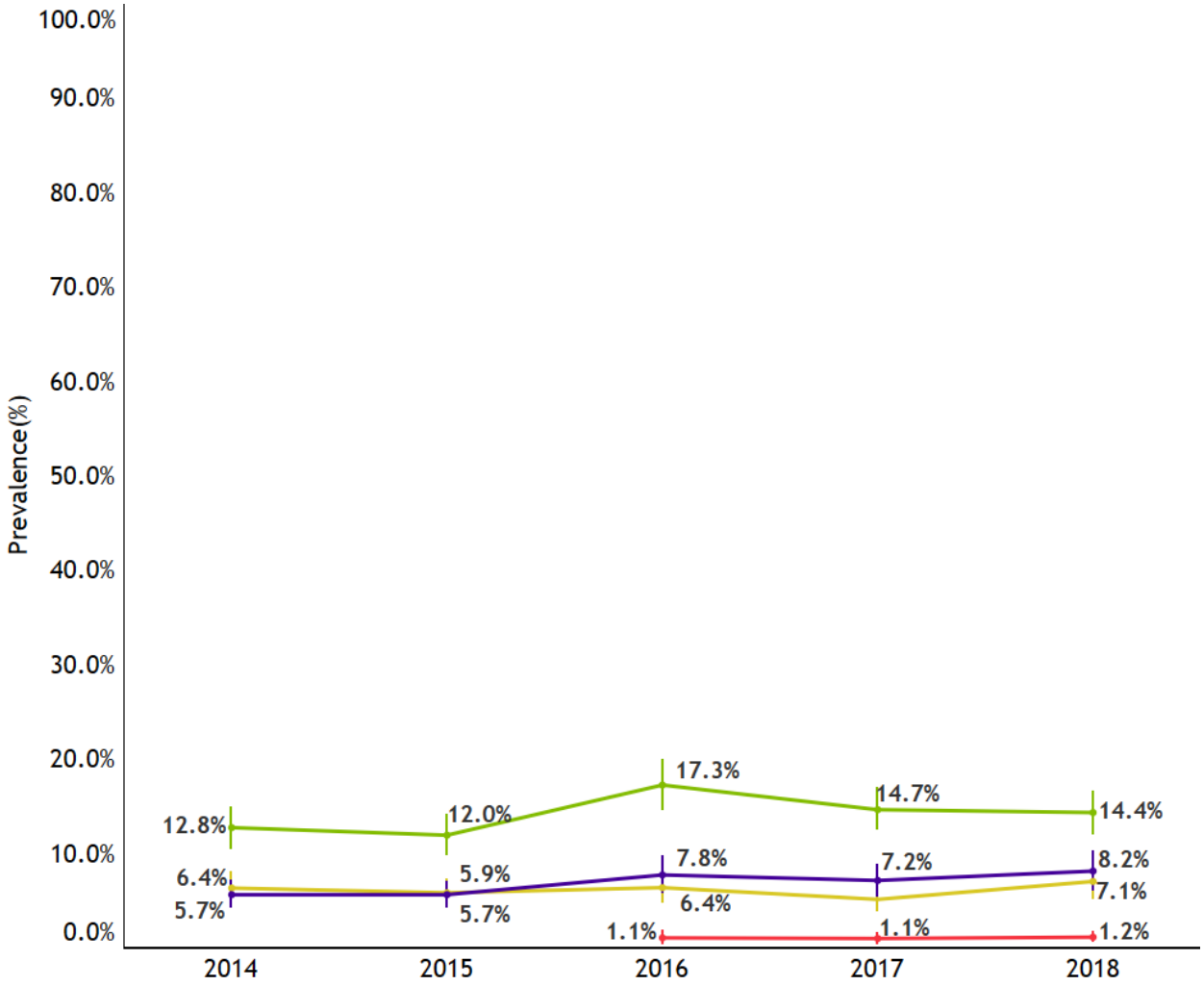
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Pregnancy Risk Assessment Monitoring System

Figure Notes:
*Before pregnancy is defined as use three months before becoming pregnant
**During pregnancy is calculated by combining use in the first 3 months of pregnancy, last 3 months of pregnancy, or at any time during pregnancy questions
***Postpartum-currently breastfeeding is calculated as currently breastfeeding at time of survey and used marijuana after birth
95% Confidence Intervals indicated by bars

- Before Pregnancy
- During Pregnancy
- Postpartum
- Postpartum and Currently Breastfeeding

Figure 18: Annual prevalence of substance use during* pregnancy, Colorado 2014-2018



Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Pregnancy Risk Assessment Monitoring System

Figure Notes:
*During pregancy is defined as the last three months of pregnancy for alcohol, cigarettes, and electronic cigarettes and calculated by combining the first 3 months, last 3 months, and at any time during pregnancy questions for marijuana
95% Confidence Intervals indicated by bars

- Alcohol
- Marijuana
- Cigarettes
- Electronic cigarettes

Section 2: Scientific Literature Review on Health Effects of Marijuana use/consumption

Background

The Colorado Department of Public Health and Environment (CDPHE) was given statutory responsibility in 25-1.5-110, C.R.S. to:

> "… monitor changes … in the emerging science and medical information relevant to the health effects associated with marijuana use." and
>
> "… appoint a panel of health care professionals with expertise in, but not limited to, neuroscience, epidemiology, toxicology, cannabis physiology, and cannabis quality control to further direct policy."

Based on this charge, CDPHE appointed a 14-member committee, the Retail Marijuana Public Health Advisory Committee (RMPHAC), to review scientific literature on the health effects of marijuana. Members of the RMPHAC all have various expertise in cannabis physiology. Each individual member brings additional expertise from their respected fields of study: emergency medicine, epidemiology, injury prevention, laboratory science, medical toxicology, mental and behavioral health, neonatology and obstetrics, neuroscience, pediatric medicine, pharmacology, pulmonary medicine, and substance abuse. A roster of current committee members, along with their stated conflicts of interest, can be found at www.marijuanahealthinfo.colorado.gov/advisory-committee.

The RMPHAC is charged with the duties as outlined in 25-1.5-110 C.R.S. to "…establish criteria for studies to be reviewed, reviewing studies and other data, and making recommendations, as appropriate, for policies intended to protect consumers of marijuana or marijuana products and the general public." To satisfy this charge, the RMPHAC meets regularly throughout the year to review the scientific literature currently available on health effects of marijuana use/consumption, evaluates findings without bias , openly discuss the science applying expert opinion, comes to consensus on the science, translates the science into public health messages, makes policy-related recommendations,

recommends surveillance activities, plus identifies and addresses gaps in the science important to public health.

In 2014, the RMPHAC implemented an unbiased and transparent process for evaluating scientific literature and data on marijuana use/consumption and health outcomes. The RMPHAC uses a standardized systematic literature review process to search and grade the existing scientific literature on the health effects of marijuana. Findings are synthesized into evidence statements that summarize the quantity and quality of scientific evidence supporting an association between marijuana use/consumption and a health outcome.

These evidence statements are classified as follows:

- **Substantial evidence** - indicates robust scientific findings that support an association between marijuana use/consumption and the outcome.
- **Moderate evidence** - indicates scientific findings that support an association between marijuana use/consumption and the outcome, but these findings have some limitations.
- **Limited evidence** - indicates modest scientific findings that support an association between marijuana use/consumption and the outcome, but these findings have significant limitations.
- **Mixed evidence** - indicates both supporting and opposing scientific findings for an association between marijuana use/consumption and the outcome, with neither direction dominating.
- **Insufficient evidence** - indicates the outcome has not been sufficiently studied to conclude whether or not there is an association between marijuana use/consumption and the outcome.
- **Body of research failing to show an association** - indicates the topic has been researched without evidence of an association; is further classified as a limited, moderate, or substantial body of research.

The RMPHAC also translates these evidence statements into plain language so they are understandable to the public for future use in public health messaging. In addition, the RMPHAC develops public health recommendations based on potential concerns identified through the review process and articulates research gaps based on common limitations of existing research. All of this work is performed by the full committee during open public meetings with opportunities for stakeholder input. Final statements, recommendations and research gaps are formally approved by a majority vote of the RMPHAC.

The topics for review were originally chosen in 2014 based on recently published peer-reviewed publications outlining the potential health effects of marijuana use/consumption and public health priorities identified from key informant interviews of local public health officials across Colorado,

including in urban, rural, and resort communities. Since then, additional topics were added. These additional topics were collected through an ongoing process for stakeholders to submit suggestions to the RMPHAC for future topics. Key findings for each topic are presented below. More detailed findings, including information on individual studies, are available at www.marijuanahealthinfo.colorado.gov/Literature-review.

Limitations

An important note for all key findings is that the available research evaluated the **association** between marijuana use/consumption and potential adverse health outcomes. This **association** does not prove that marijuana use/consumption alone **caused** the effect. Despite the best efforts of researchers to account for confounding factors, there may be other important factors related to **causality** that were not identified. In addition, marijuana use/consumption was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use/consumption. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use/consumption. Another limitation of the available research data is that most studies did not or could not measure the amount or percentage of THC used/consumed by subjects, nor which other cannabinoids were present. There are diverse marijuana products available in Colorado, most are higher in THC concentration than the marijuana used by study subjects for much of the literature reviewed.

The RMPHAC recognizes the limitations and biases inherent in the published literature and made efforts to ensure the information reviewed and synthesized is reflective of the current state of medical knowledge. Where information was lacking – for whatever reason – the RMPHAC identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

Summary of key findings

What's New?

Resulting from new scientific research being added to a corresponding evidence statement, the following information is based on evidence statements appearing as substantial evidence or moderate evidence and were not rated as such in our previous report.

Research shows that adolescents and young adults who use weekly, or more frequently, are more likely to experience ongoing cognitive and academic impairment for at least 28 days after last use. Marijuana use is also associated with suicidal thoughts or attempting suicide in this population. Additionally, for adolescents and young adults, using marijuana with higher THC concentration (>10% THC) is associated with continued use and future mental health symptoms and disorders. Similarly, adult use/consumption of marijuana with THC concentration >10% is associated with future psychotic disorders, like schizophrenia. Marijuana use/consumption under the age of 55 years is associated with an increased risk for stroke. Research investigating how substance use impacts dating violence found that young adult women who use/consume marijuana are unlikely to perpetuate physical dating violence.

The tables following each topic area in this section include the RMPHAC's most prominent findings from reviews of scientific literature on associated health effects with marijuana use/consumption.

Marijuana use among adolescents and young adults

The RMPHAC reviewed the relationships between adolescent and young adult marijuana use and cognitive abilities, academic performance, mental health, and future substance use. Weekly marijuana use by adolescents is associated with deficits in academic and cognitive abilities, even 28 days after last use. Weekly use is also associated with failure to graduate from high school or complete a college degree. Adolescents and young adults who use marijuana are more likely to experience psychotic symptoms as adults (such as hallucinations, paranoia, and delusional beliefs), future psychotic disorders (such as schizophrenia) and suicidal thoughts or attempting suicide. Evidence shows that adolescents who use marijuana can become addicted to marijuana, and that treatment for marijuana addiction can decrease use and dependence. Additionally, those who quit using marijuana have lower risks of adverse cognitive and mental health outcomes than those who continue to use. Marijuana use is also associated with future use and use disorder for tobacco, alcohol, and other drugs. Adolescent use of marijuana with higher THC concentration (>10% THC) is associated with continued use and development of future mental health symptoms and disorders.

Marijuana use among adolescents and young adults		
	Substantial evidence	**Moderate evidence**
Benefits of quitting	Treatment for cannabis use disorder can reduce use and dependence	Quitting or decreasing marijuana use lowers the risk of adverse mental health outcomes
Cognitive and academic effects	Weekly, or more frequent, use is associated with a lower rate of graduating high school	Weekly, or more frequent, use is associated with a lower rate of attaining a college degree (among those who start a degree program)
		Weekly, or more frequent, use is associated with ongoing cognitive and academic impairment for at least 28 days after last use
Mental health	Daily or near daily use is associated with future psychotic disorders like schizophrenia	Marijuana use is associated with suicidal thoughts or attempting suicide
	Use is associated with future psychotic symptoms (likelihood increases with more frequent use)	
Substance use, abuse, and addiction	Those who use marijuana can develop cannabis use disorder (addiction)	Marijuana use is associated with future use and use disorder for alcohol
	Marijuana use is associated with future use and use disorder for marijuana, tobacco and other drugs	

High THC (%) concentration		Using marijuana with higher THC concentration (>10% THC) is associated with continued use
		Use of marijuana with higher THC concentration (>10% THC) is associated with future mental health symptoms and disorders

Marijuana use/consumption and cancer

The RMPHAC reviewed different forms of cancer relative to marijuana use/consumption, as well as the chemicals released in marijuana smoke and vapor. Strong evidence shows marijuana smoke contains many of the same cancer-causing chemicals found in tobacco smoke and is associated with pre-cancerous lesions in the airway. However, there is conflicting research for whether or not marijuana smoking is associated with lung cancer. Marijuana use/consumption is associated with testicular cancer, and limited evidence also suggests an association between marijuana use/consumption and prostate cancer. On the other hand, the limited evidence available concerning cancers of the bladder, head and neck suggests they might not have any association with marijuana use/consumption.

Marijuana use/consumption and cancer		
	Substantial evidence	**Moderate evidence**
Cancer and precancerous lesions	Daily or near daily use is associated with pre-cancerous lesions in airway	Smoking less than the equivalent of one joint per day for 10 years is not associated with lung cancer
Chemicals in MJ smoke or vapor	Marijuana smoke contains many of the same cancer causing chemicals as tobacco smoke	

Genitourinary Cancer		Use among adult males is associated with increased risk of nonseminoma testicular cancer

Marijuana use/consumption and cardiovascular effects

The RMPHAC reviewed myocardial infarction, stroke, and death from cardiovascular causes relative to marijuana use/consumption. Evidence shows that marijuana use/consumption increases the risk of stroke in individuals younger than age 55. Limited scientific evidence shows that marijuana use/consumption may increase the risk of heart attack and risk of death related to a cardiovascular event, acutely or over time.

Marijuana use/consumption and cardiovascular effects		
	Substantial evidence	**Moderate evidence**
		Marijuana users/consumers younger than 55 years of age are at an increased risk of stroke

Marijuana dose and drug interactions

The RMPHAC reviewed THC (tetrahydrocannabinol, the main psychoactive component of marijuana) levels relative to marijuana dose and method of use, the effects of secondhand marijuana smoke, drug-drug interactions involving marijuana, and relationships between marijuana and opioid use. One important finding is that it can take up to four hours after consuming an edible marijuana product to reach the peak THC blood concentration and feel the full effects. There is credible evidence of clinically important drug-drug interactions between marijuana and multiple medications, including some anti-seizure medications and a common blood-thinner. Data about potential interactions are lacking for many drugs at this time and are likely to evolve substantially in the coming years. There is some evidence that hospitalizations and deaths due to opioid pain medication overdose are less prevalent in states with legal and accessible medical marijuana compared to states without. There is

conflicting evidence for whether or not marijuana use/consumption is associated with a decrease in opioid use among chronic pain patients or individuals with a history of problem drug use. Limited evidence shows individuals who use/consume THC concentrate products are more likely to report symptoms of cannabis use disorder. Research is lacking concerning the health effects of secondhand marijuana smoke exposure and acute health effects resulting from THC concentrate products.

Marijuana dose and drug interactions		
	Substantial evidence	**Moderate evidence**
THC blood levels resulting from different exposures	It takes up to four hours after ingesting marijuana (edible products) to reach peak blood THC levels	Ingesting (edible products) more than 15 mg THC may produce a blood THC level above 5 ng/mL
	Smoking more than 10 mg THC produces a blood THC level near or above 5 ng/mL within 10 minutes	Inhaling vaporized THC produces a blood THC level similar to smoking the same dose
Secondhand exposure	Typical secondhand marijuana smoke exposure is unlikely to cause a positive drug screen by urine or blood	

Marijuana use/consumption and driving

The RMPHAC reviewed driving impairment and motor vehicle crash risk relative to marijuana use/consumption, as well as evidence indicating how long it takes for impairment to resolve after marijuana use/consumption. The risk of a motor vehicle crash increases among drivers with recent marijuana use/consumption. In addition, using alcohol and marijuana together increases impairment and the risk of a motor vehicle crash more than using either substance alone. For less-than-weekly marijuana users/consumers, using marijuana containing 10 milligrams or more of THC is likely to impair the ability to safely drive, bike or perform other safety-sensitive activities. Less-than-weekly users/consumers should wait at least six hours after smoking or eight hours after eating or drinking marijuana to allow time for impairment to resolve. Evidence is also showing that blood THC levels of

marijuana-impaired drivers are higher now than in the past. Research is lacking on marijuana and impairment in frequent marijuana users/consumers.

Marijuana use/consumption and driving		
	Substantial evidence	**Moderate evidence**
Combined marijuana and alcohol use	Combined use of marijuana and alcohol increases crash risk more than either substance alone	
Impairment and crash risk	Recent marijuana use/consumption by a driver increases the risk of a motor vehicle crash	Higher THC blood level increases the risk of a motor vehicle crash
	Smoking more than 10 mg THC can lead to driving impairment	Blood THC levels of impaired drivers are higher now than they were in the past
	Orally ingesting more than 10 mg THC can lead driving impairment	
	Increased risk of driving impairment at blood THC as low as 2-5 ng/mL	
Time to wait before driving	Waiting at least 6 hours after smoking less than 18 mg allows driving impairment to resolve or nearly resolve	Waiting at least 6 hours after smoking about 35 mg allows driving impairment to resolve or nearly resolve
	Waiting at least 8 hours after orally ingesting less than 18 mg allows driving impairment to resolve or nearly resolve	

Marijuana use/consumption and gastrointestinal or reproductive effects

The RMPHAC reviewed gastrointestinal diseases, particularly cyclic vomiting, and infertility or abnormal reproductive function. Evidence shows that long-time, daily or near daily marijuana use/consumption is associated with cyclic vomiting, also called cannabinoid hyperemesis syndrome. In such cases, stopping marijuana use/consumption may relieve the vomiting. There is limited research showing marijuana use/consumption is associated with male infertility or abnormal reproductive function, however, the research is conflicting for women.

Marijuana use/consumption and gastrointestinal and reproductive effects		
	Substantial evidence	**Moderate evidence**
Cyclic vomiting		Cyclic vomiting can occur with long-time, daily or near daily marijuana use/consumption (cannabinoid hyperemesis syndrome)

Marijuana use/consumption and injury

The RMPHAC reviewed workplace, recreational and other non-driving injuries, burns from hash-oil extraction or failed electronic smoking devices, and physical dating violence. Evidence shows marijuana use/consumption may increase the risk of workplace injury while impaired but is unclear for other types of non-driving- related injury. There have been many reports of severe burns resulting from home-extraction of butane hash oil leading to explosions, and cases of electronic smoking devices exploding, leading to trauma and burns. Concerning dating violence, young adults who use marijuana are unlikely to commit or be victims of physical dating violence. Additionally, adolescent girls who use marijuana may be more likely to commit physical violence against their dating partners, and adolescent boys who use marijuana may be more likely to be victims of physical dating violence.

Marijuana use/consumption and injury		
	Substantial evidence	**Moderate evidence**
Physical dating violence		Young adult women who use marijuana are unlikely to perpetrate physical dating violence

Marijuana use/consumption and neurological, cognitive, and mental health effects

The RMPHAC reviewed the potential relationships between marijuana use/consumption and cognitive impairment, mental health disorders, and substance abuse among adults. Strong evidence shows that those who use marijuana daily or near daily are more likely to have impaired memory lasting more than a week after quitting. An important acute effect of THC is psychotic symptoms, such as hallucinations, paranoia, and delusional beliefs during intoxication, and these symptoms are worse with higher doses. Daily or near daily marijuana use/consumption and using marijuana with THC concentration >10% is associated with developing a psychotic disorder such as schizophrenia. Finally, evidence shows marijuana users/consumers can experience withdrawal and become addicted to marijuana, and treatment for marijuana addiction can decrease use and dependence.

Marijuana use/consumption and neurological, cognitive, mental health effects		
	Substantial evidence	**Moderate evidence**
Cognitive effects	Daily or near daily use is associated with Impaired memory for at least 7 days	
Mental health effects	Use is associated with acute psychotic symptoms during intoxication, which are worse with higher doses	
	Daily or near daily use is associated with future psychotic disorders like schizophrenia	Use of marijuana with THC concentration >10% is associated with future psychotic disorders like schizophrenia
Substance use, abuse and addiction	Those who use marijuana can develop cannabis use disorder (addiction)	
	Treatment for cannabis use disorder can reduce use and dependence	
	Those using daily or near daily can experience withdrawal symptoms when abstaining	

Marijuana use/consumption during pregnancy and breastfeeding

The RMPHAC reviewed adverse birth outcomes, effects of prenatal marijuana use/consumption on exposed offspring later in childhood or adolescence, and effects of marijuana use/consumption by a breastfeeding mother. Biological evidence shows THC passes through the placenta to the fetus, so the unborn child is exposed to THC if the mother uses marijuana, and THC passes through breast milk to a breastfeeding child. Marijuana use/consumption during pregnancy may be associated with an increased risk of birth defects, heart defects in offspring, stillbirth, small for gestational age, and sudden infant death syndrome (SIDS). Stronger evidence was found for effects that are seen in the exposed offspring months or years after birth if a child's mother used marijuana while pregnant with the child. These include impaired cognitive function and attention. Decreased academic ability, decreased growth, increased depression symptoms, initiation of marijuana use/consumption, and childhood behavior problems may also occur in exposed offspring.

Marijuana use/consumption during pregnancy and breastfeeding		
	Substantial evidence	**Moderate evidence**
Effects on exposed offspring		Prenatal marijuana exposure is associated with reduced cognitive function and IQ scores in childhood
		Prenatal marijuana exposure is associated with attention problems in childhood
Biological evidence concerning marijuana use/consumption during pregnancy and breastfeeding		
THC is passed through the placenta of women who use marijuana, the fetus absorbs and metabolizes the THC, and THC metabolites are found in the meconium.		
THC is present in the breast milk of women who use marijuana. Infants who drink breast milk containing THC absorb and metabolize the THC.		

Marijuana use/consumption and respiratory effects

The RMPHAC reviewed respiratory diseases such as chronic obstructive pulmonary disorder (COPD), chronic bronchitis and asthma, respiratory infections, and lung function relative to smoked marijuana. It also reviewed potential health effects of vaporized marijuana. Strong evidence shows an association between daily or near daily marijuana use/consumption and chronic bronchitis, with cough, wheezing and mucus. Additionally, daily or near daily marijuana use/consumption may be associated with bullous lung disease leading to pneumothorax in individuals younger than 40 years of age and less-than-weekly use with small airway obstruction. Frequent smokers who switch from marijuana smoking to marijuana vaporizing may have fewer respiratory symptoms and improved pulmonary function. Finally, a notable effect of acute use is a short-term improvement in lung airflow.

Marijuana use/consumption and respiratory effects		
	Substantial evidence	**Moderate evidence**
Smoked marijuana	Use is associated with chronic bronchitis with cough, wheezing and mucus	
	Acute use is associated with short-term lung airflow improvement *	

*While these effects have been scientifically observed, marijuana should not be used to intentionally improve short-term lung airflow.

Unintentional marijuana exposures in children

The RMPHAC reviewed unintentional marijuana exposure relative to marijuana legalization and child-resistant packaging. They found strong evidence that more unintentional marijuana exposures of children occur in states with increased legal access to marijuana, and that exposures can lead to significant clinical effects requiring hospitalization. Additionally, evidence shows child-resistant packaging prevents exposure to children from potentially harmful substances, such as THC.

Unintentional marijuana exposure in children		
	Substantial evidence	**Moderate evidence**
	Legal marijuana access increases unintentional marijuana exposures in children	Child-resistant packaging reduces unintentional pediatric poisonings

Public health recommendations

It is important to improve data quality by systematically collecting information on the frequency, amount, THC content, and method of marijuana use/consumption in both public health surveillance and medical care settings. Clinicians should routinely screen for marijuana use/consumption during hospitalizations and emergency department visits, especially among pregnant or adolescent patients, and follow-up questions should clarify the timing, frequency, and amount of last use and use patterns. Improved testing methods and documentation are needed when testing drivers involved in motor vehicle crashes or suspected of driving under the influence of drugs (DUID).

Questions regarding marijuana use/consumption should be continued on population-based surveys such as the Behavioral Risk Factor Surveillance System, the Healthy Kids Colorado Survey and Pregnancy Risk Assessment Monitoring System Surveillance methods should be expanded to collect more detailed information, such as quantity and methods of use, THC content of products used, perceptions of risk, and reasons for using and adverse effects experienced. To better assess potential health impacts, data on hospitalizations and emergency department visits related to marijuana use/consumption should be further explored to identify diagnoses more prevalent among those who use marijuana and to clarify when marijuana was or was not a likely contributor to a hospitalization or ED visit. Additionally, THC concentration among marijuana products available on the regulated retail market in Colorado should be monitored over time.

Public education on potential health effects of marijuana is important, particularly related to the effects of use during pregnancy, adolescent use, driving after using, increasing THC concentration of products and unsafe storage around children. Marijuana dispensaries and representatives of the marijuana industry should continue to partner with public health in disseminating education about these topics of highest concern. Education for health care providers on the need for marijuana use/consumption screening and the known health effects of marijuana use/consumption may encourage more open dialog between providers and patients.

Research gaps

Important research gaps related to the health effects of marijuana use/consumption were identified during the literature and data review process. These research gaps were based on frequently noted limitations of existing research or issues important to public education or policymaking.

Research gaps particularly important to public health and safety include the need for: 1) research on the effects of marijuana use/consumption on pregnant women and their offspring, including marijuana use/consumption concurrent with breastfeeding; 2) research on marijuana containing THC concentrations consistent with currently available products (higher THC); 3) research on health effects among individuals who have used marijuana frequently for a long period of time; 4) research on driving impairment among people who use marijuana more than weekly and may have developed tolerance; 5) research to better characterize the pharmacokinetics/pharmacodynamics, potential drug interactions, health effects, and impairment related to non-smoking methods of marijuana use/consumption such as edibles and vaporizing as well as other cannabinoids such as cannabidiol (CBD); and 6) research to better describe the risk of adverse health effects due to marijuana contamination related to fungi, heavy metals, and pesticides.

Two areas that could be improved in new research are measurements of marijuana exposures and measurements of health outcomes. Studies should use better and more standardized indicators of marijuana use/consumption, including frequency, dose, THC content (% or mg THC), and route of exposure of marijuana use/consumption, length of abstinence, and cumulative lifetime marijuana exposure. A particularly important need is the separate evaluation of health effects among those who use daily or near daily and those who use less frequently. Researchers should also consider stratifying study groups by age, gender, or other characteristics when the health effect being studied could differ among these groups, such as by age for cardiovascular effects or by gender for mental health effects. Finally, one strong step toward providing valuable research data on would be a community-based cohort to study both beneficial and adverse health effects of marijuana use/consumption.

Identifying these research gaps helps researchers and funding sources to prioritize areas of research related to marijuana use/consumption and public health. While outside the scope of this committee's duties, the RMPHAC also recognizes the need for more research on the potential therapeutic benefits of marijuana. The RMPHAC strongly recommends Colorado continue to support research to fill these important gaps in public health knowledge.

Section 3: Monitoring Marijuana-Related Health Effects in Colorado

Background

This chapter reviews surveillance efforts of the CDPHE to monitor the potential population-based health effects of legalized marijuana. Through 25-1.5-110, C.R.S., CDPHE was given statutory authority to:

> "The department may collect Colorado-specific data that involves health outcomes associated with cannabis from, but not limited to, all-payer claims data, hospital discharge data, and available peer-reviewed research studies."

The purpose of this data collection and analysis as stated in 25-1.5-110 C.R.S. is to "… monitor the emerging science and medical information relevant to the health effects associated with marijuana use/consumption." The data analyses reported in this section were reviewed by the Retail Marijuana Public Health Advisory Committee as outlined in 25-1.5-110 C.R.S. to help "… make recommendations as appropriate, for policies intended to protect consumers of marijuana or marijuana products and the general public."

This section covers analysis of two secondary datasets used to monitor: 1) reported exposures of marijuana products through poison center calls and 2) hospital and emergency department discharges with marijuana-related billing codes.

Data sources

Rocky Mountain Poison and Drug Safety

Rocky Mountain Poison and Drug Safety (RMPDS) serves as the regional poison center for Colorado. RMPDS provides medical information to health care providers and the public to reduce toxicity, injury, and disease related to exposures of all kinds. RMPDS has been providing information and assistance to Colorado and the surrounding region for more than 50 years. RMPDS participates in the American Association of Poison Control Centers' National Poison Data System (NPDS). RMPDS and NPDS call-volume data are used by public health, pharmaceutical and medical institutions for research, education, and prevention initiatives in Colorado and throughout the nation. The volume of poison

center calls are typically used as a surrogate data source to determine the potential for adverse health effects from exposure to chemicals, environmental agents, biotoxins and drugs. RMPDS data are a near "real-time" data source available to public health professionals. This section examines the frequency of human cases (case level) and marijuana products (product level) that were reported to RMPDS from 2000 to 2019. Also examined are potential trends in the number of case exposures reported related to marijuana over time and legalization periods.

Colorado Hospital Association

The Colorado Hospital Association (CHA) manages administrative data on hospitalizations and emergency department (ED) discharges from participating member hospitals in Colorado. The data include patient demographics, visit characteristics, admission and discharge dates, discharge diagnosis/billing codes, and procedure codes. Coding is assigned by the facility per the International Classification of Diseases Clinical Modification (ICD-CM) manual. The majority of acute care hospitals and emergency departments in Colorado are included in this data source. The following definitions were used to examine rates of marijuana-related billing codes in hospitalizations and ED discharge: Details of what billing codes were included in these definitions and their descriptions can be found on our report website at:

marijuanahealthinfo.colorado.gov/health-data/colorado-hospital-association-cha-data

- **Definition 1: Marijuana-related billing codes** included any hospitalization or ED discharge with at least one marijuana-related ICD-9/10-CM billing code in the up to 30 listed billing codes for each discharge.
- **Definition 2: Marijuana poisoning billing codes** included any hospitalization or ED discharge with at least one marijuana initial poisoning or adverse effect ICD-9/10-CM billing code in the up to 30 listed billing codes for each discharge.
- **Definition 3: Marijuana use/consumption, abuse, or dependence billing codes** included any hospitalization or ED discharge with at least one marijuana use/consumption, abuse, or dependence ICD-9/10-CM billing code in the up to 30 listed billing codes for each discharge.

Limitations

RMPDS data are limited in that it is a voluntary reporting system; not every person experiencing marijuana-related adverse health symptoms or requiring medical attention following a marijuana exposure reports it to the poison center. Additionally, a proportion of calls to the poison center reporting marijuana exposures come from healthcare providers seeking additional information and consultation on treatment of marijuana exposures. As providers learn how to manage exposures,

these reported marijuana exposures to the poison center may decrease. Nevertheless, these data reveal important trends to monitor through time.

It is important to consider the limitations of CHA data to avoid misinterpreting these findings. CHA hospital and ED discharge data are limited in that they rely on billing codes to identify marijuana involvement. The codes used in this data are intended for billing purposes. *Presence of marijuana-related code(s) does not indicate marijuana caused an adverse health effect or healthcare encounter*. Rather, marijuana billing codes may indicate increased marijuana exposure or use/consumption in the community or identify that marijuana use/consumption was discussed in the patient's care during that encounter. These billing codes may capture a provider's routine screening for marijuana use/consumption, the patient reporting marijuana use/consumption, or referral to counseling for marijuana use/consumption cessation. It may also include past histories of marijuana use/consumption, acute intoxications of marijuana, marijuana effects that lead to adverse health symptoms like hyperemesis, or trauma caused by motor vehicle crashes resulting from marijuana intoxication. Use of marijuana-related billing codes has not been standardized or validated. However, this data source is the best currently available for monitoring trends in potential adverse health effects related to marijuana. Additionally, the billing codes were changed in October 2015 when ICD-9-CM transitioned to ICD-10-CM. The transition also increased the number of available marijuana codes. For these reasons, discharge rates before the transition may not be directly comparable to rates afterwards. The ICD-10 transition is notated by a vertical, dotted line on all hospital and ED figures.

Summary of key findings

The most prominent findings from RMPDS and CHA are described below. All findings and detailed results of these data sources can be found at: www.marijuanahealthinfo.colorado.gov/health-data

Reported marijuana exposures to Rocky Mountain Poison and Drug Safety

Number of reported marijuana exposures trending upward in Colorado

The number of reported marijuana case-level exposures reported to RMPDS has increased since 2010; however, remains consistently lower compared to alcohol exposures (***Figure 19***). Marijuana case exposures increased an average 5.6 cases per year from 2000 to 2013. After retail marijuana became available in 2014, reported marijuana case exposures increased an average 10.6 cases annually from 2015 to 2019. Since our last report, reported marijuana exposure have increased from 222 in 2017 to 276 in 2019.

Two thirds of reported marijuana product exposures involve edible or plant marijuana product

Two thirds of marijuana exposures involved marijuana edible products (n=121, 43.7%) and plant products (n=70, 27.8%; ***Figure 20***). Concentrated extracts and other marijuana products (e.g. topical, pills and other unknown products) accounted for 19.1% (n=53) of the product exposures. This trend has been consistent since 2017 when this level of detail in the data became available. Since our last report, edibles continue to be the marijuana product type attributed to the most exposures among children 0 to 5 years (36 in 2017 to 56 in 2019), however exposures to plant, concentrated extracts, cannabidiol (CBD), and other types of marijuana products also increased in this age group in 2019 (***Figure 21***).

Highest number of marijuana exposures reported in children 0 to 5 years

The number of reported marijuana exposures among children, specifically children between the ages of 0 to 5 years, began consistently increasing in 2013 (***Figure 22***). Starting in 2013, marijuana exposures among children ages 0 to 5 years increased an average 12.6 exposures annually. In 2017, this age group represented a quarter of all marijuana exposure reports (n=56). In 2019, reported exposures among children 0 to 5 years was the highest to date (n=103) representing 37.7% of all marijuana exposures and has surpassed exposure reports among adults 30 years and older for two consecutive years.

Increases in number of exposures correlates with increases among unintentional, marijuana only exposures in children ages 0-5

In 2019, 81.5% of marijuana exposures reported to RMPDS involved marijuana only (n=225), with fewer exposures (n=51) involving marijuana and other substance exposure (***Figure 23***). Unintentional marijuana only exposures have steadily increased an average 14.8 per year starting in 2013 (***Figure 24***). For the past two consecutive years, more than half of marijuana-only exposures reported were unintentional: 54.2% (n=122) in 2019.

Unintentional, marijuana-only exposures have been consistently highest among children ages 0 to 5. Since our last report, there have been sharp increases in the percentage of marijuana exposures reported in this age group representing 75.9% (n=95; ***Figure 25***) in 2019 compared to 47.2% (n=37) in 2016.

Hospital and emergency department discharges in Colorado with marijuana-related billing codes

ED discharges with a marijuana-related billing code decreased overall in 2019, but increased in children 9 years or younger

In 2019, ED discharges with a marijuana-related billing code (definition 1) significantly decreased from 1,170.6 to 860.5 per 100,000 discharges; the lowest annual rate seen since the transition to ICD-10 in 2016. The significant decrease occurred across most demographics (age, sex, race) with the exception of children less than 9 years old. Since our last report, ED discharges among children less than 9 years old with a marijuana-related billing code have significantly increased from 24.5 in 2017 to 40.6 per 100,000 discharges in 2019. ED discharges with a marijuana-related billing code (definition 1) were highest among males (1,105.8 per 100,000), young adults 18-25 years old (1,856.8 per 100,000), and African Americans (1,217.1 per 100,000).

Hospital discharges with a marijuana-related billing code remain stable

In 2019, 3,515.0 per 100,000 hospital discharges had a marijuana-related billing code (definition 1). Hospital discharge rates with marijuana-related billing codes were highest among males (4,694.3 per 100,000), young adults 18 to 25 years old (10,574.4 per 100,000), and African Americans (7,656.5 per 100,000).

ED and hospital discharges with a marijuana-related billing code are lower than discharges with alcohol and opioid codes

The rate of ED and hospital discharges with marijuana-related billing codes (definition 1) have remained lower than discharges with alcohol-related billing codes since 2011 and 2004 respectfully. In 2019, the rate of ED discharges with marijuana-related billing codes were lower than the rates of stimulant- and opioid-related billing codes for the first time (***Figure 26***). Hospital discharges with marijuana-related billing codes have remained lower than opioid-related billing rates with the exception of rates that occurred during the ICD transition (***Figure 27***). Hospital discharges with at least one marijuana-related billing code have remained higher than cocaine- and stimulant-related billing codes since 2000. Alcohol-related billing codes remain the highest of all substance-related discharges.

ED and hospital discharge rates with marijuana-related poisoning or adverse events increasing

The rate of ED discharges with marijuana-related poisoning or adverse event billing codes (definition 2) significantly increased annually since 2016 (***Figure 28***) with the sharpest increases occurring in 2018 (54.8 per 100,000 discharges) and 2019 (71.5 per 100,000 discharges). In 2019, the first significant

increase in the rate of hospital discharges with marijuana-related poisoning or adverse event billing codes (definition 2) since the ICD transition in 2016.

There have been significant increases in marijuana-related poisoning and adverse events (definition 2) among all age groups (***Figure 29***). Since our last report, the largest increase in ED discharges were among young adults 18 to 25 years followed by adults 26 to 34 years. In 2019, 171.4 per 100,000 young adult 18 to 25 years discharges and 119.9 per 100,000 adult 26 to 34 years discharges had at least one marijuana-related poisoning or adverse event billing code.

Discussion

The data presented from RMPDS and CHA provide important insights into the potential health effects and public health impacts associated with marijuana use/consumption. *However, the overall trends provided do not tell the whole story.* There are other important factors to consider in determining marijuana-related health effects. Age is important when considering vulnerability, whether the marijuana product was knowingly or intentionally consumed, and other health conditions that may be contributing factors to the health effect. More detail in the data is important in understanding the context of the event. Both RMPDS and CHA data have improved over the past few years. RMPDS data now specificity marijuana product type involved in reported exposures. In CHA data, the transition to ICD-10-CM codes has provided more detail about hospital and ED discharges, specifying marijuana-related poisoning or adverse events, use, abuse and dependence. Although these improvements are helpful in better describing the relationships seen in the data, more detailed analyses are needed on the performance of these codes to correctly identify and associate marijuana as the main contributing factor.

Encouraging trends

- The number of marijuana exposure reports to the poison center among adults 30 years and older have decreased compared to 2017.
- The overall rate of ED discharges with marijuana-related use, abuse, or dependence billing codes (definition 3) significantly decreased in 2019.
- The overall rate of hospital discharges with marijuana-related use, abuse, or dependence ICD-10 billing codes (definition 3) in 2019 was not statistically different compared to 2016 (the first full year to use ICD-10 billing codes).

Trends to continue monitoring

- Marijuana exposure reports to the poison center increased in 2018, with increases most attributed to unintentional, marijuana-only exposures among children 0 to 5 years.

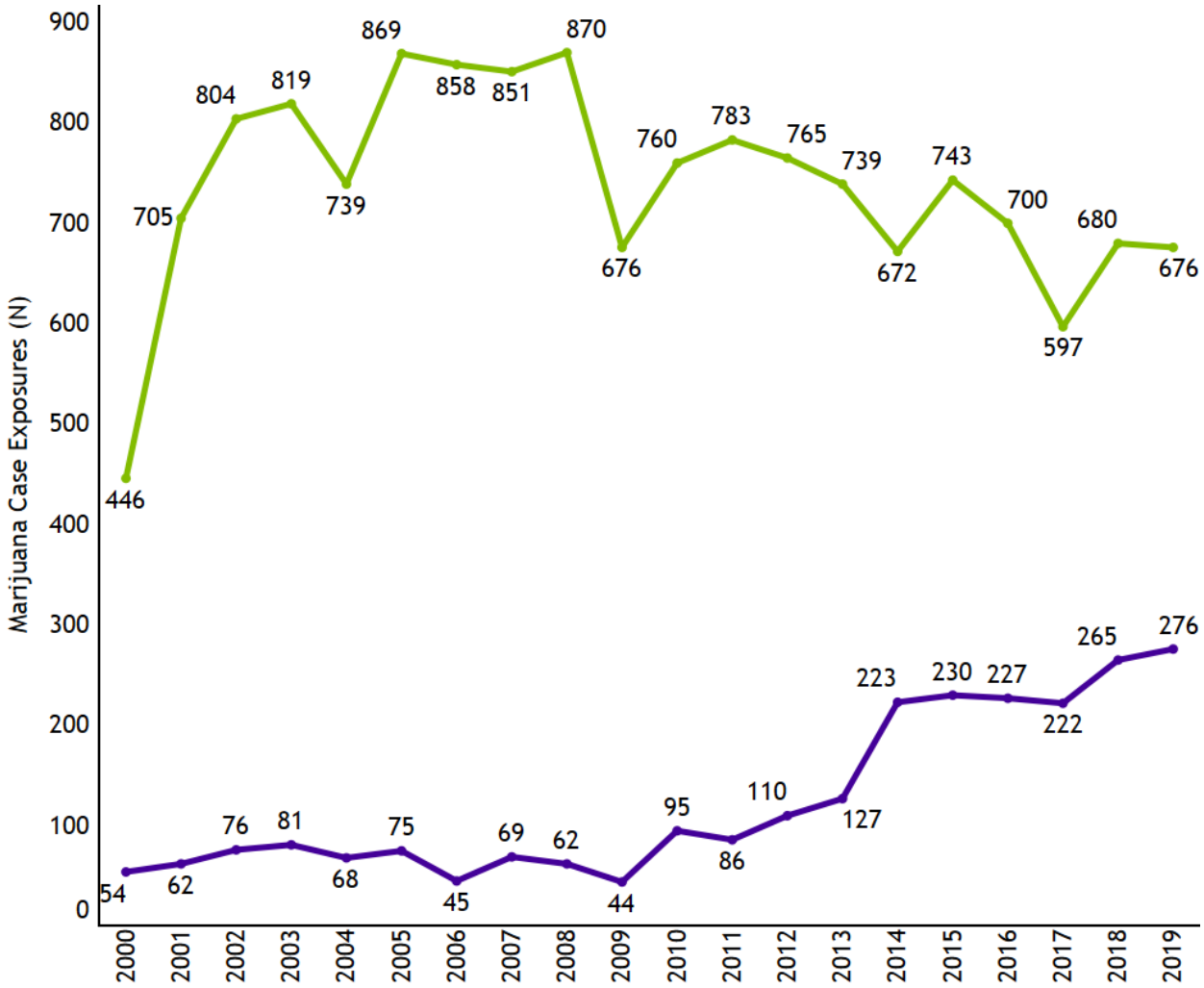
- Edibles continue to account for the highest proportion of marijuana product exposures. Exposures reported to the poison center about edible marijuana products are the highest among children 0 to 5 years old.
- Marijuana-related poisoning or adverse event rates have significantly increased compared to ED and hospital rates in 2017. Significant increases were the highest among young adults 18 to 25 years followed by adults 26 to 34 years old.
- ED discharges with any marijuana billing code (definition 1) increased among children less than 9 years old.
- Disparities in hospitalizations and emergency department visits with all marijuana-related billing codes (definition 1) also existed by sex and race, with higher rates among males and African Americans.

Recommendations and future directions

1. Until a validated case definition is developed, CDPHE should continue using reported exposures to the poison center and hospital and emergency department discharges to monitor trends in potential marijuana-related adverse health effects.
2. Continue to monitor reported marijuana exposures to the poison center, including reason and product type of marijuana exposure. CDPHE and RMPDS will continue working together on a surveillance project that captures additional information such as product name, source, and THC concentration in reported marijuana exposures. CDPHE will continue to partner with RMPDS to monitor this new data source.
3. Perform more detailed analyses on unintentional exposures to marijuana among young children. This includes collecting additional primary data from medical records to assess the severity of the outcome, the source of the exposure and possible public health intervention strategies.
4. Further analyze hospitalization and emergency department billing codes data to assess primary diagnoses, in relation to marijuana-related billing codes.
5. Continue to partner with other state and local agencies to collect new data regarding marijuana use/consumption associated with adverse health events, injury or death including route of exposure, product type and dose of THC.
6. More large prospective studies are needed to identify health outcomes more definitively linked to acute and chronic marijuana use/consumption.
7. Consensus recommendations from national organizations on how to monitor marijuana-related adverse health effects for the general population and for conditions that may be associated with marijuana use/consumption are needed to guide state and national surveillance.

Section 3 Figures

Figure 19: Annual frequency of reported marijuana case exposures compared to alcohol case exposures, Colorado 2000-2019



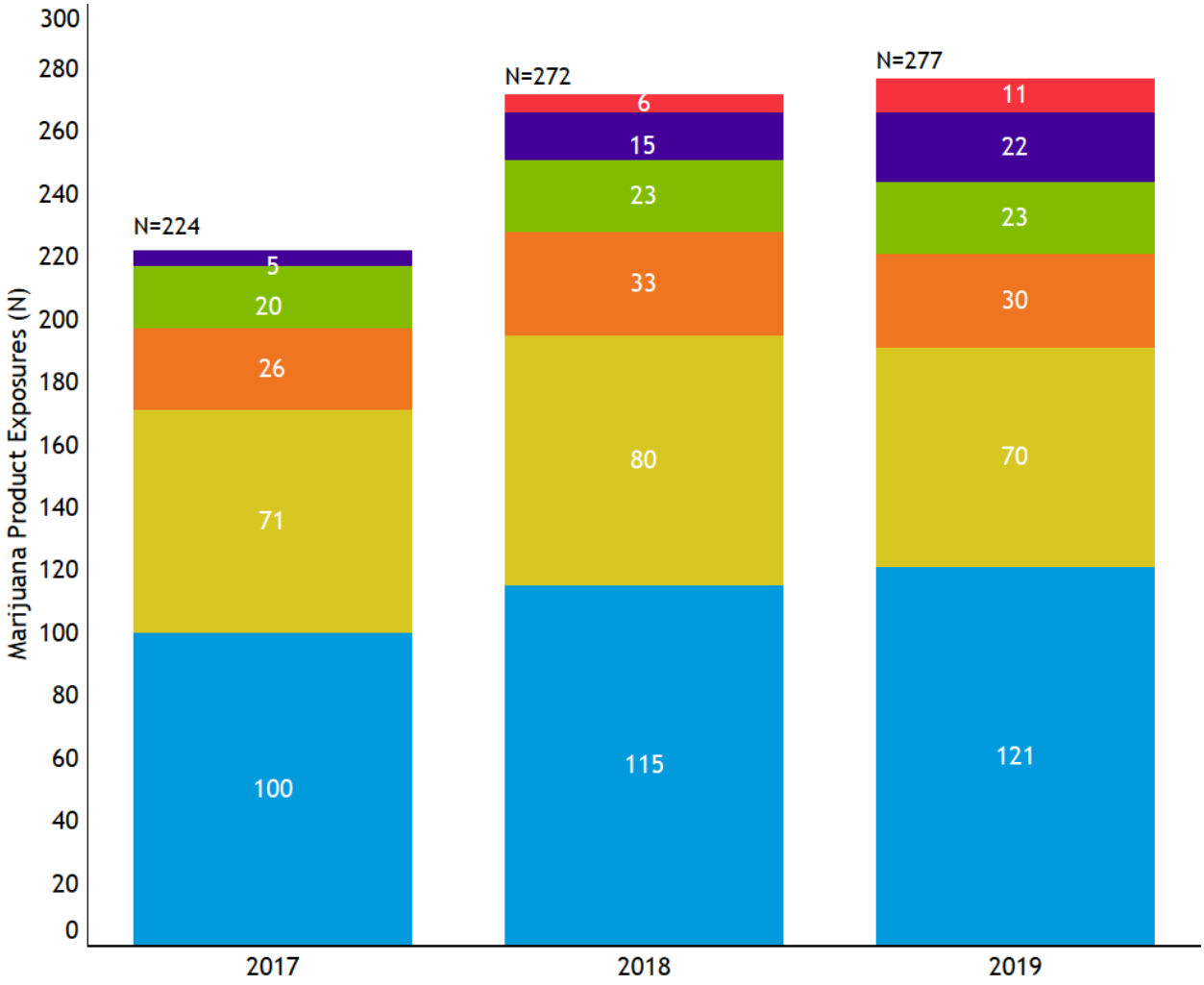
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:

Alcohol Marijuana

Figure 20: Annual frequency of marijuana product exposures reported to RMPDS, Colorado 2017-2019



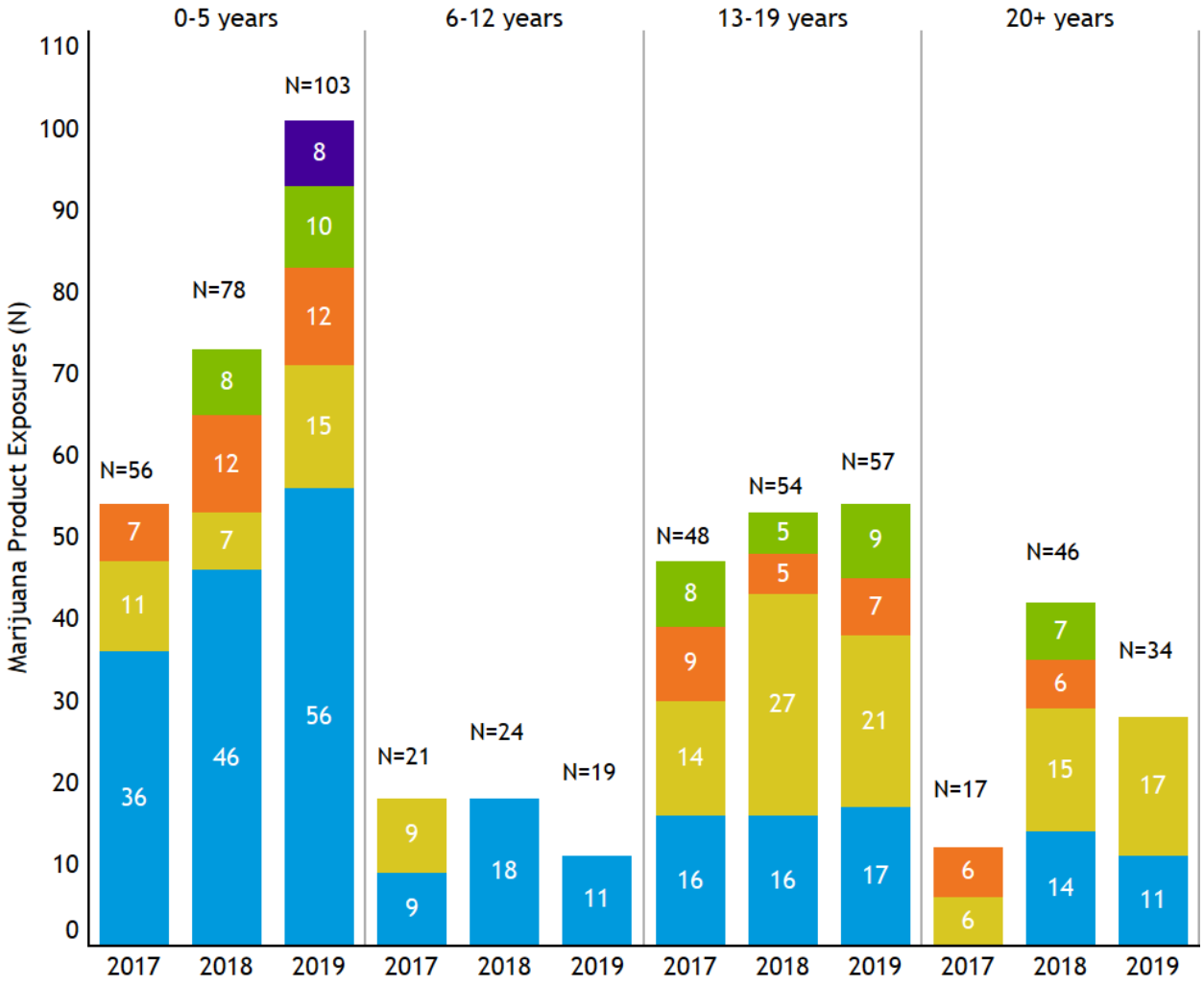
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

- Electronic Device/Liquid
- Cannabidiol (CBD)
- Concentrated Extract
- Other
- Plant
- Edible

Figure 21: Annual frequency of marijuana product exposures reported to RMPDS by age group, Colorado 2017-2019



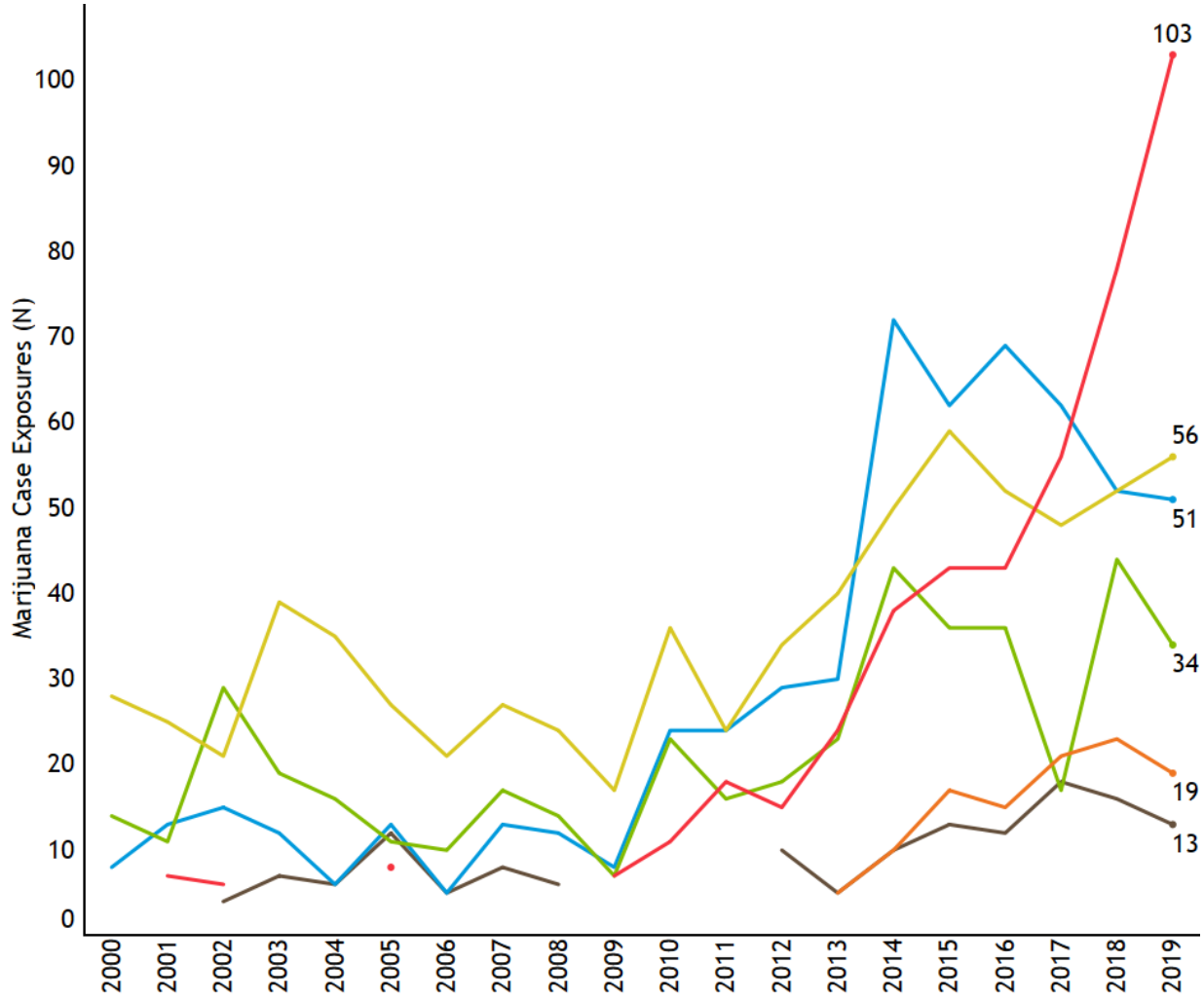
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

- Cannabidiol (CBD)
- Concentrated Extract
- Other
- Plant
- Edible

Figure 22: Annual frequency of marijuana case exposures reported to RMPDS by age group, Colorado 2000-2019



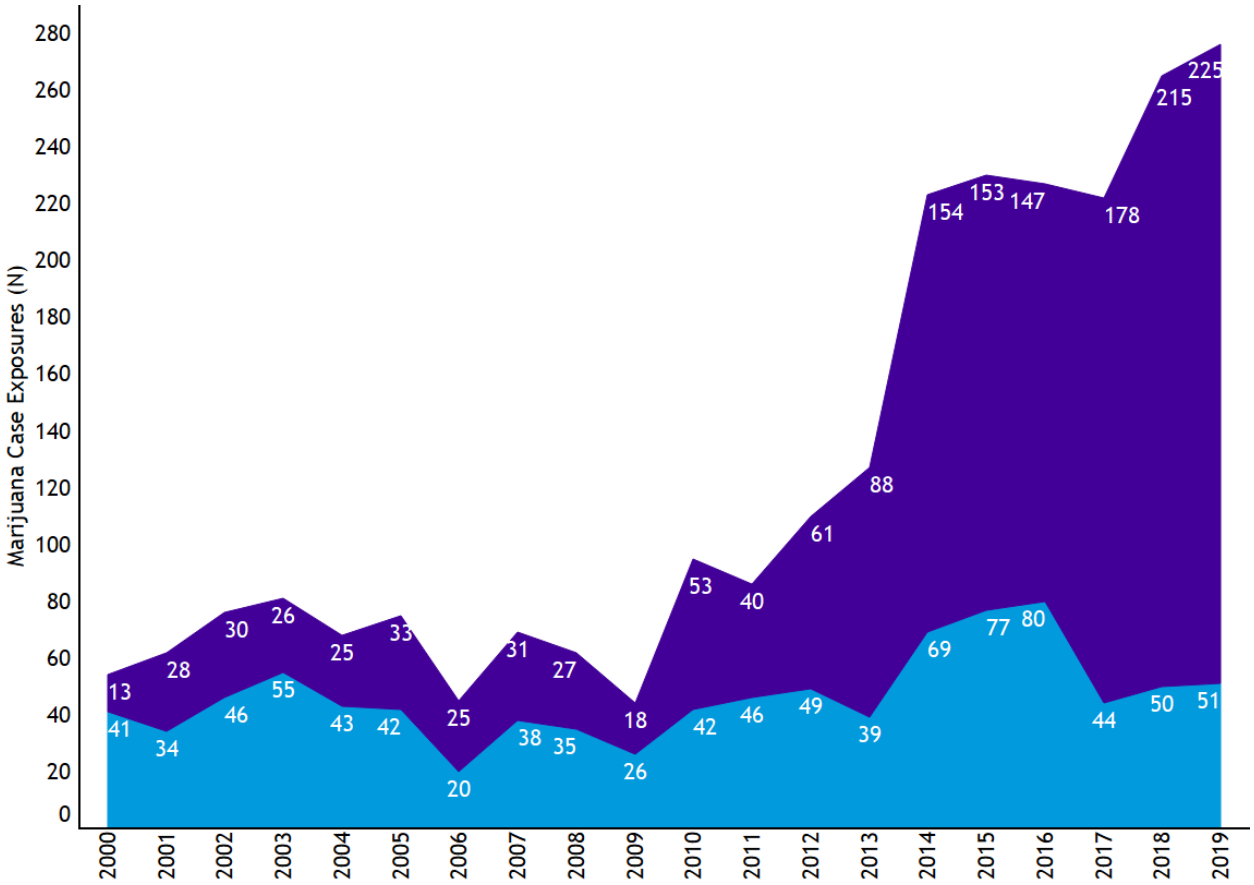
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

- 0-5 years
- 6-12 years
- 13-19 years
- 20-29 years
- 30+ years
- Unknown Age

Figure 23: Annual frequency of marijuana-only exposures compared to exposures with marijuana and additional substances reported to Colorado Poison Center, Colorado 2000-2019



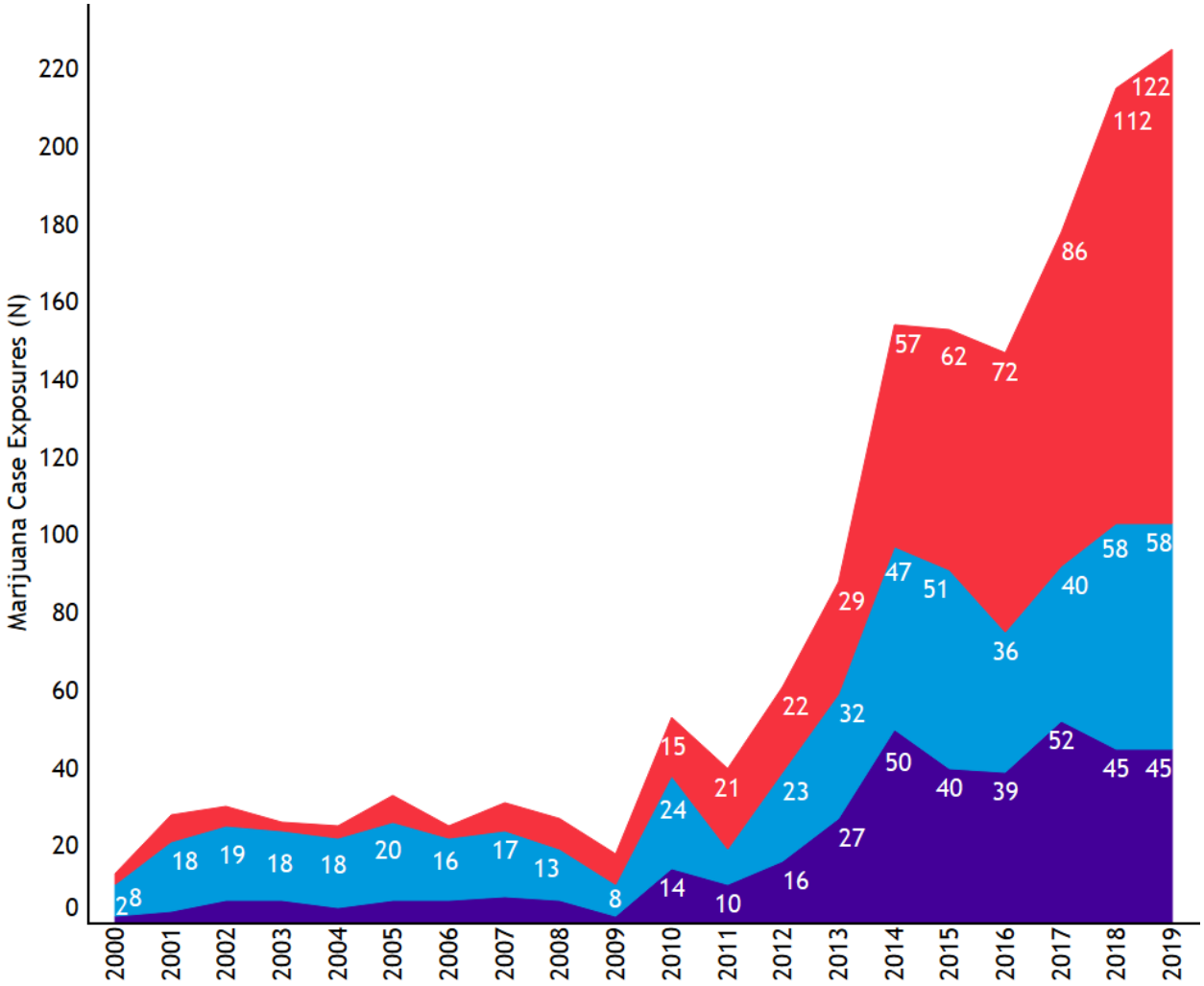
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

Marijuana Only
Marijuana & Other Products

Figure 24: Annual exposure reason among marijuana-only case exposures reported to RMPDS, Colorado 2000-2019



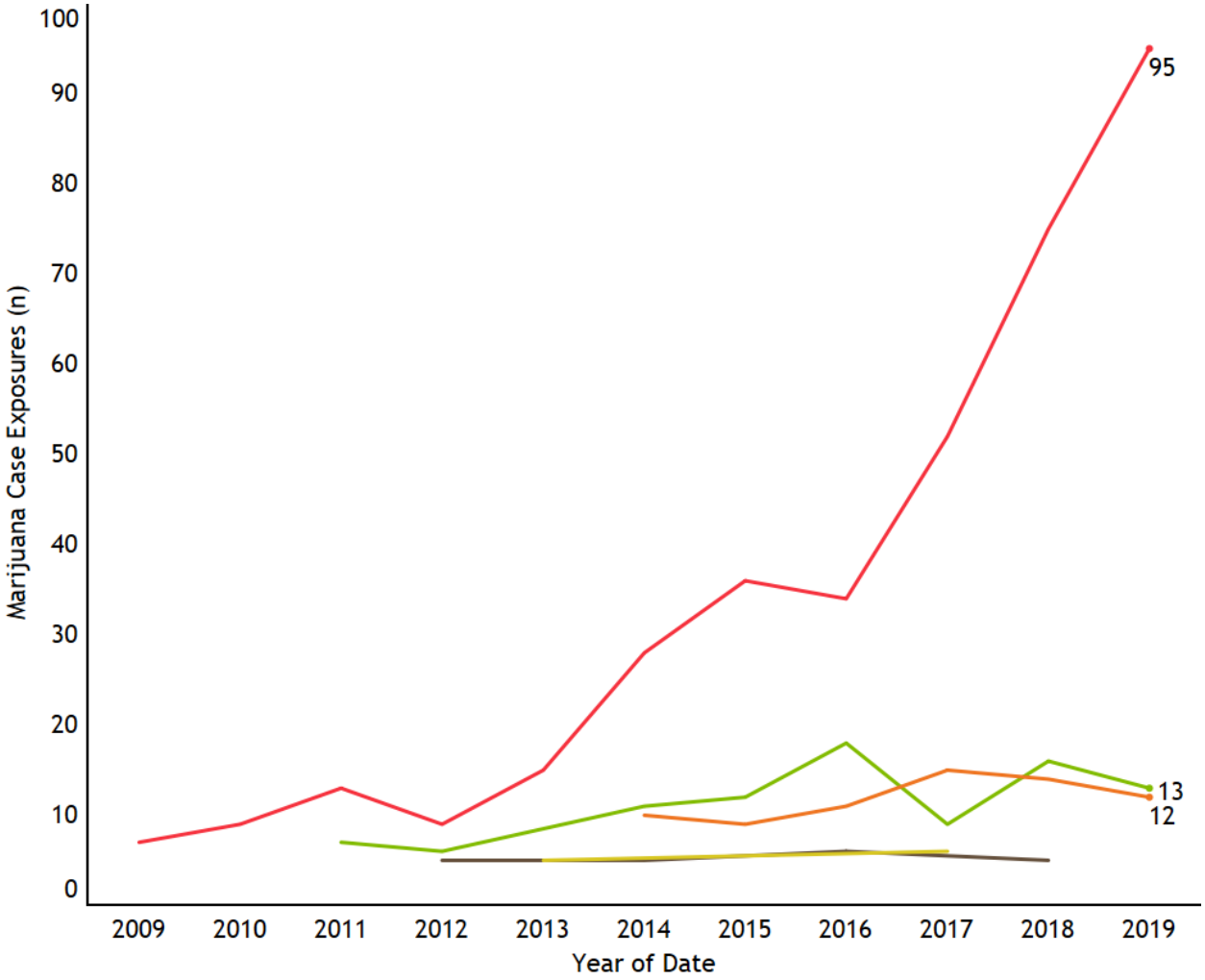
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

- Unintentional
- Intentional
- Adverse Effects/Other

Figure 25: Annual frequency of unintentional, marijuana-only exposure among marijuana case exposures reported to RMPDS by age group, Colorado 2000-2019



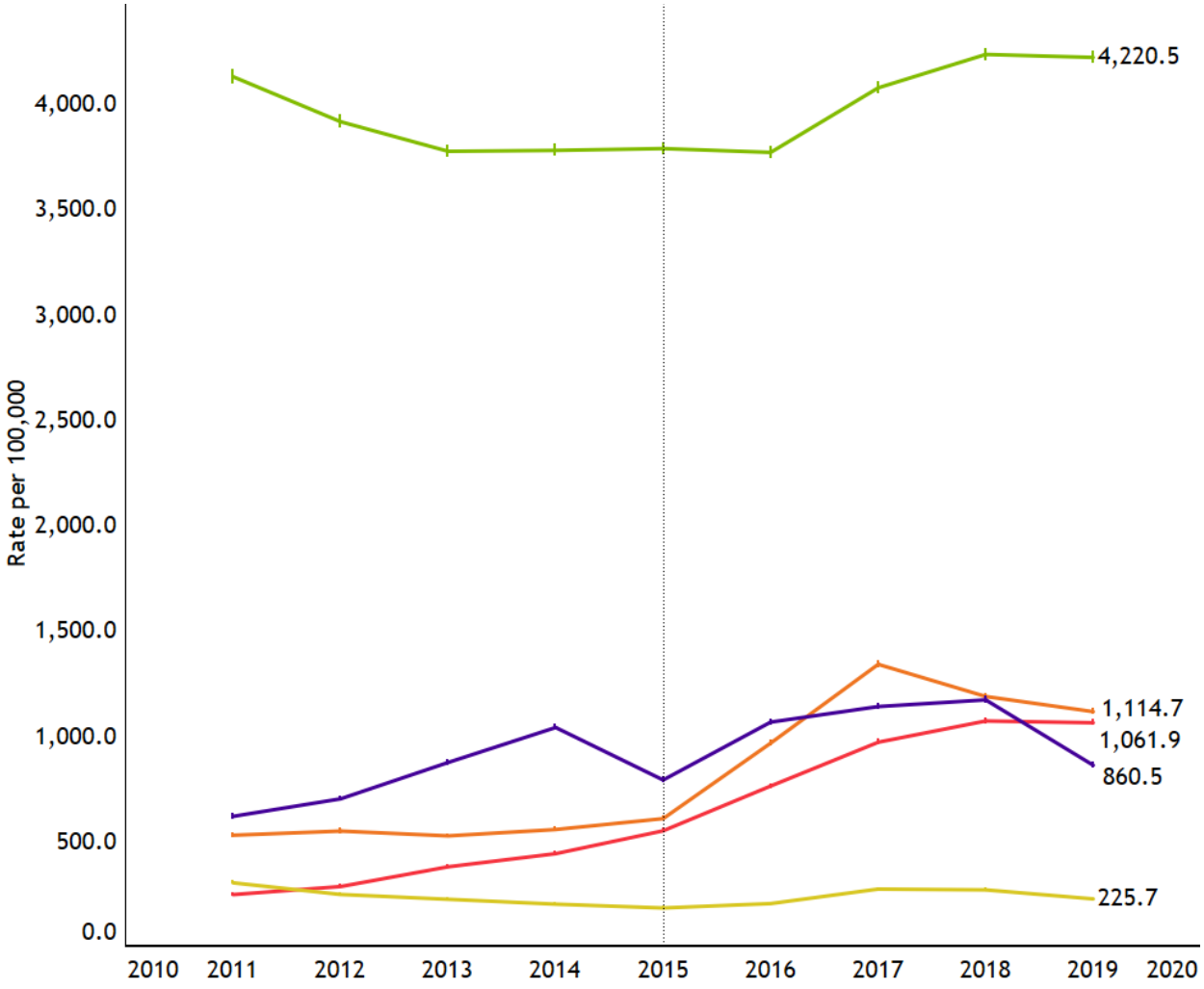
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Rocky Mountain Poison and Drug Safety

Figure Notes:
Counts less than 5 are suppressed from figure

- 0-5 years
- 6-12 years
- 13-19 years
- 20+ years
- Unknown Age

Figure 26: Annual crude rate of emergency department discharges with substance-related billing codes per 100,000 discharges, Colorado 2011-2019



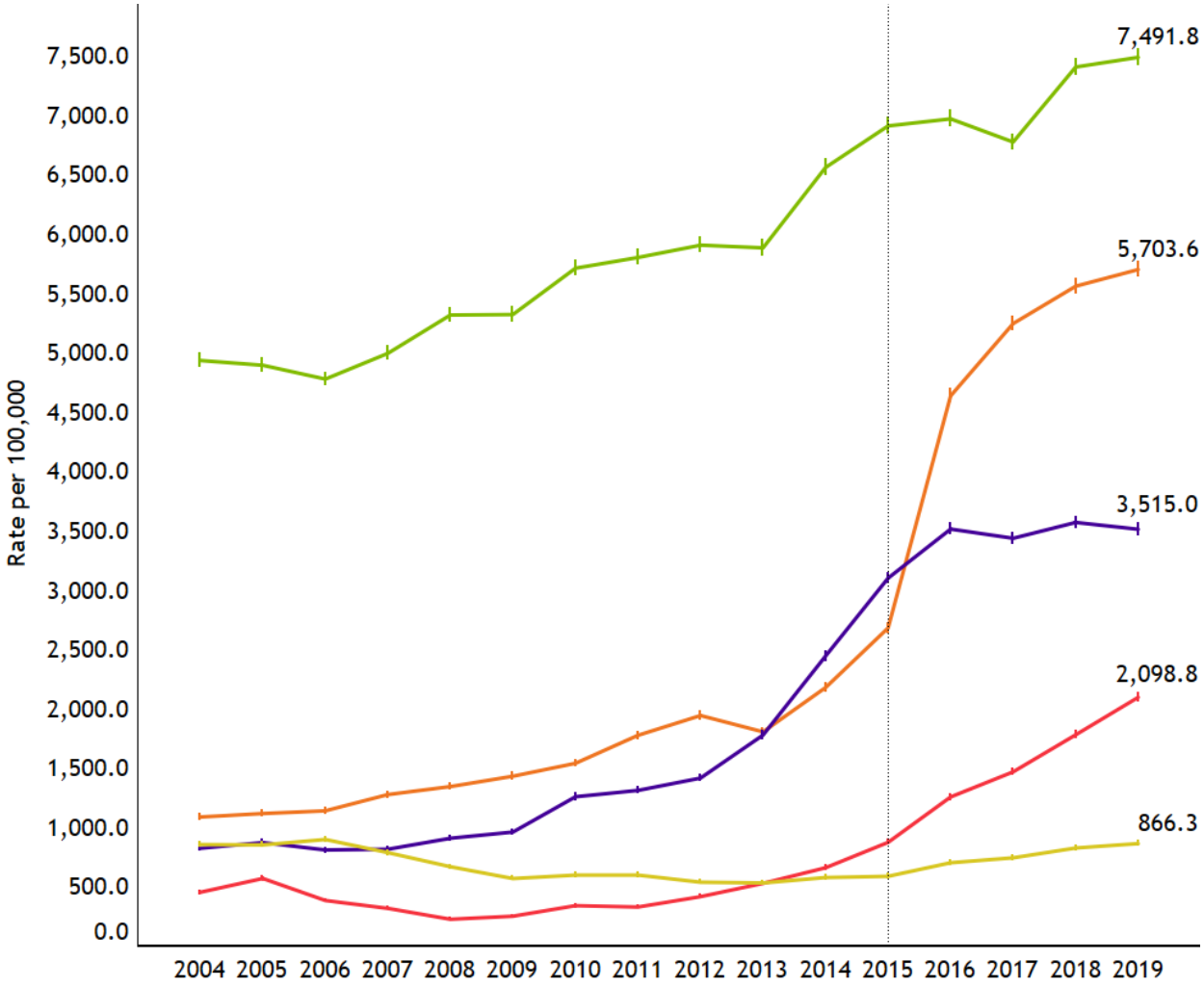
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Colorado Hospital Association

Figure Notes:
95% Confidence Intervals indicated by bars
Transition from ICD-9 to ICD-10 in 2015 is indicated by dotted line. Rates before transition (2004-2014) may not be directly comparable to rates after (2016-2019)

- Alcohol
- Cocaine
- Marijuana
- Opioids
- Stimulants

Figure 27: Annual crude rate of hospital discharges with substance-related billing codes per 100,000 discharges, Colorado 2004-2019



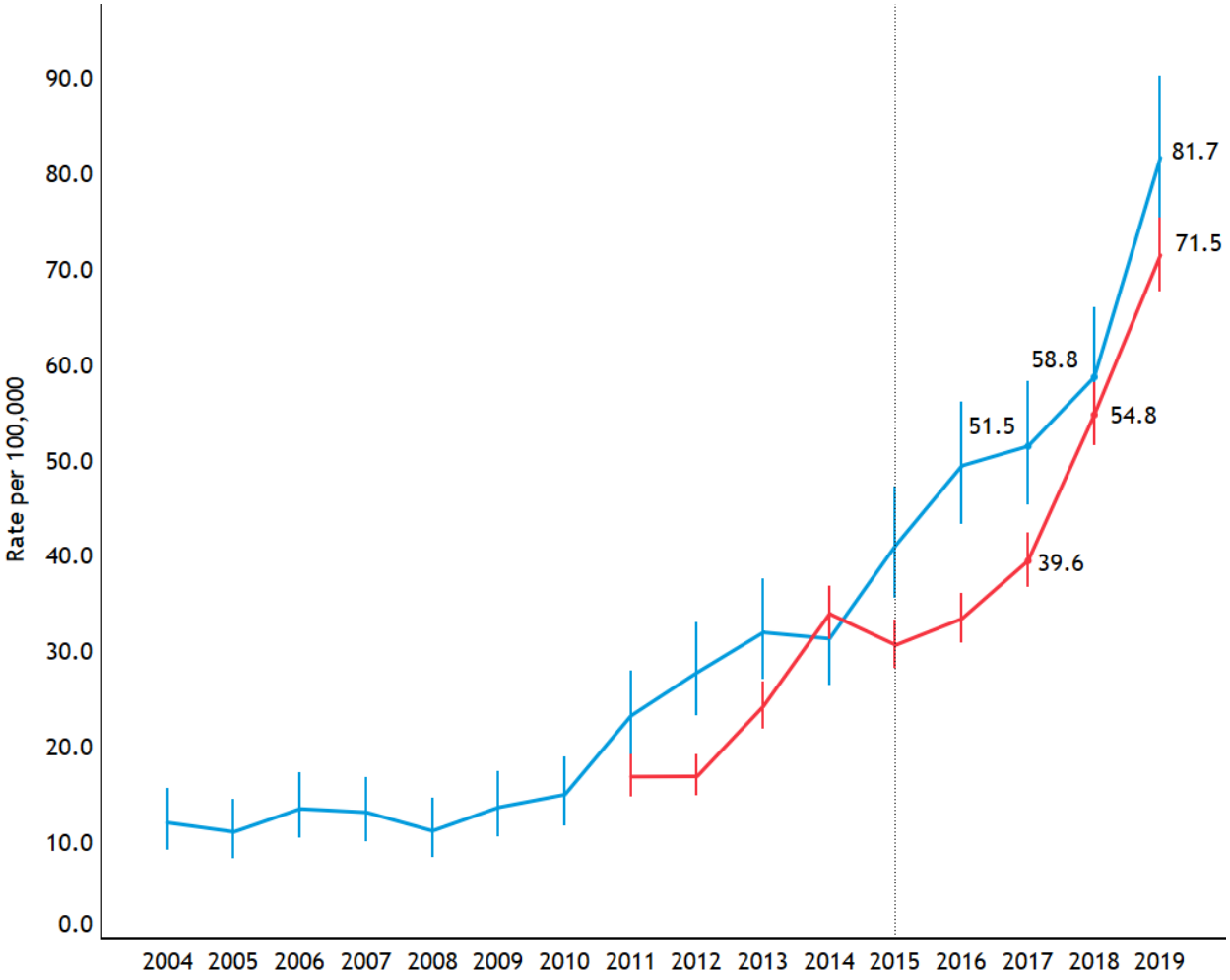
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Colorado Hospital Association

Figure Notes:
95% Confidence Intervals indicated by bars
Transition from ICD-9 to ICD-10 in 2015 is indicated by dotted line. Rates before transition (2004-2014) may not be directly comparable to rates after (2016-2019)

- Alcohol
- Cocaine
- Marijuana
- Opioids
- Stimulants

Figure 28: Annual crude rate of discharges with marijuana-related poisoning or adverse event billing codes per 100,000 discharges, Colorado 2004-2019



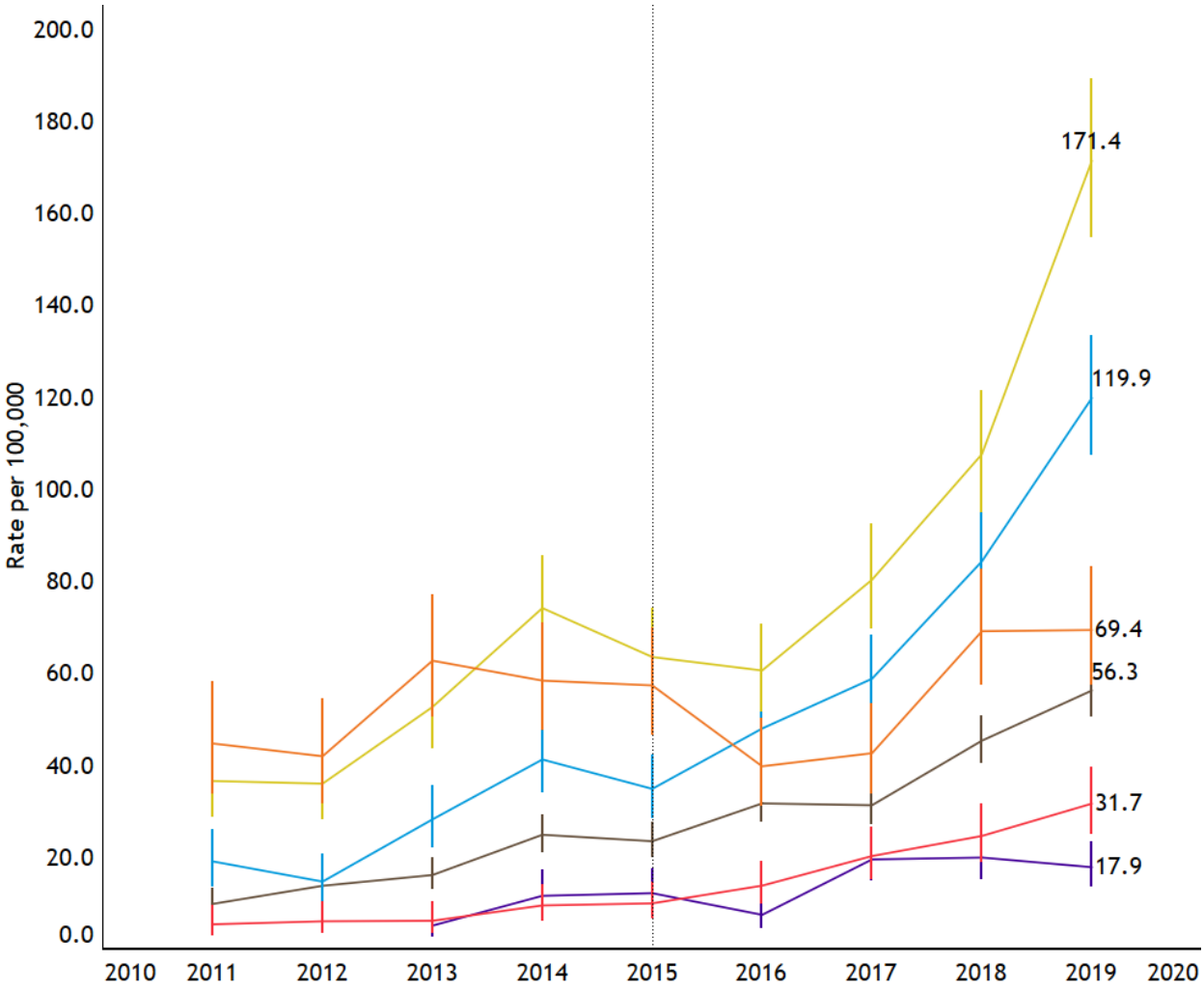
Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Colorado Hospital Association

Figure Notes:
95% Confidence Intervals indicated by bars
Transition from ICD-9 to ICD-10 in 2015 is indicated by dotted line. Rates before transition (2004-2014) may not be directly comparable to rates after (2016-2019)

Emergency Department
Hospital

Figure 29: Annual crude rate of emergency department discharges with marijuana-related poisoning or adverse event billing codes per 100,000 discharges by age group, Colorado 2000-2019



Produced by: Marijuana Health Monitoring Program, Colorado Department of Public Health and Environment 2020

Data Source: Colorado Hospital Association

Figure Notes:
95% Confidence Intervals indicated by bars
Transition from ICD-9 to ICD-10 in 2015 is indicated by dotted line. Rates before transition (2004-2014) may not be directly comparable to rates after (2016-2019)

- <9 years
- 9-17 years
- 18-25 years
- 26-34 years
- 35-64 years
- 65+ years