

## **Monitoring Health Concerns Related to Marijuana in Colorado: 2016**

### **Section 1: Monitoring Changes in Marijuana Use Patterns**

#### **Encouraging trends:**

- For adults and adolescents, past-month marijuana use has not changed since legalization either in terms of the number of people using or the frequency of use among users.
- Based on the most comprehensive data available, past-month marijuana use among Colorado adolescents is nearly identical to the national average.
- We have not identified any new disparities in marijuana use by age, gender, race, ethnicity or sexual orientation since legalization.
- Daily or near-daily marijuana use among adults is much lower than daily or near-daily alcohol or tobacco use. Among adolescents, past month marijuana use is lower than past month alcohol use.

### **Chapter 1: Behavioral Risk Factor Surveillance System (BRFSS) 2014-2015 Survey Results**

#### **Major Findings:**

- Ever marijuana use among Colorado adults (18+ years) was not statistically different from 2014 to 2015.
- Current marijuana use (marijuana use at least once in the past 30 days) among adults was not statistically different from 2014 to 2015.
- BRFSS estimated current marijuana use among Colorado adults was not statistically different from 2014 to 2015.
- NSDUH estimated current marijuana use among Colorado adults was not statistically different from 2014 to 2015.
- In 2015, the NSDUH estimate for current marijuana use among Colorado adults was statistically higher than the BRFSS estimate.
- NSDUH estimates of current marijuana use among Colorado adults from 2006-2015 were statistically higher than the national estimates for adult current marijuana use for each year.
- The prevalence of Colorado adults who drove a vehicle when using marijuana in the past 30 days was not statistically different from 2014 to 2015.
- In both 2014 and 2015, daily or near daily marijuana use among adults was statistically higher than monthly or weekly marijuana use.
- Current marijuana use was statistically lower among adults 35 years and older than among adults 18-25 years or 26-34 years of age in both 2014 and 2015.
- Current marijuana use was statistically higher among male adults compared to female adults in both 2014 and 2015.
- There were no statistical differences in estimates of current marijuana use from 2014 to 2015 within any of the race/ethnicity groups: Hispanic, White, Black, Multiracial, or Other Race.
- Current marijuana use was higher among those who reported Gay, Lesbian, Bisexual, or Other sexual orientation compared to those who reported Heterosexual orientation in both 2014 and 2015.

- The prevalence of daily or near daily marijuana use among Colorado adults was statistically lower than daily or near daily alcohol or tobacco use in both 2014 and 2015.
- Daily or near daily marijuana use was statistically lower among adults 35 years and older than among those 18-25 or 26-34 years of age in both 2014 and 2015.
- Reported dabbing marijuana in the past 30 days was statistically lower among Colorado adults aged 35 years and older than among those 18-25 or 26-34 years of age.
- Approximately half of adults who currently use marijuana use it through multiple methods.
- The prevalence of Colorado adults who used marijuana multiple methods in the past 30 days was statistically higher than those who only smoked, only vaporized, only ate/drank, and only dabbled in the past 30 days.

## **Chapter 2: Child Health Survey (CHS) 2014-2015 Survey Results**

### **Major Findings:**

- The prevalence of marijuana or marijuana products in or around homes where children live was not statistically different between 2014 and 2015.
- The prevalence of marijuana being used inside homes where children live was not statistically different between 2014 and 2015.
- The prevalence of marijuana being stored safely in homes where children live was not statistically different between 2014 and 2015.
- Among adults who use marijuana in a home where children live, the prevalence of ‘smoked, vaporized or dabbled’ was statistically higher than ‘ate or drank’.

## **Chapter 3: Healthy Kids Colorado Survey (HKCS) 2005-2015 Survey Results:**

### **Major Findings:**

- HKCS estimates for both ever and current marijuana use in Colorado have had no statistical difference from the YRBS national estimates from 2005 through 2015, except for current use in 2013.
- In 2013, the HKCS estimate of current marijuana use among high school students in Colorado was statistically lower than the YRBS national estimate.
- Comparing 2015 HKCS estimates with 2013, there was no statistical difference in current use or ever use among Colorado high school students.
- The 2015 HKCS estimates for both ever and current marijuana use among high school students in Colorado were nearly identical to the 2015 YRBS national estimates.
- From 2005 to 2013, the HKCS estimates of current marijuana use among high school students in Colorado were higher than the NSDUH estimates for current marijuana use among high school aged adolescents in Colorado. However, the difference became smaller in 2013.
- Among Colorado high school students, over the years 2005 to 2015, estimates of current marijuana use have fluctuated between 19.7% and 24.8%. None of these estimates were statistically different from each other.

- Among Colorado high school students, over the years 2005 to 2015, estimates of having ever used marijuana have fluctuated between 36.9% and 42.6%. None of these estimates were statistically different from each other.
- Among Colorado middle school students in 2015, an estimated 4.4% were currently using marijuana and an estimated 7.6% had ever used marijuana. Between 2011 and 2015, none of the estimates were statistically different.
- The prevalence of current marijuana use among high school students in Colorado has remained statistically higher than current tobacco smoking from 2011 through 2015 and has remained statistically lower than current alcohol use from 2009 through 2015.
- Current alcohol use was statistically lower in 2015 compared to 2009.
- Current tobacco smoking was statistically lower in 2015 compared to 2013 and in 2013 compared to 2011.
- Current marijuana use has remained stable from 2009 through 2015 with the prevalence of current marijuana use among high school students ranging from 19.7%-24.8%.
- In both 2013 and 2015, estimates of current marijuana use among Colorado students in each grade level trended upward from 6th through 12th grade, with current use higher in older grades than younger grades.
- In both 2013 and 2015, estimated current use among Colorado 9th graders was statistically lower than among 10th graders, and current use among 10th graders was statistically lower than among 11th graders.
- Estimated current use among Colorado 11th graders was statistically higher in 2015 than it was in 2013. There was not a statistical difference in current use among all other grades between 2013 and 2015.
- The estimate of female high school students in Colorado who reported current marijuana use in 2015 was statistically higher than in 2013.
- Estimates for current marijuana use among male high school students in Colorado were nearly identical in 2013 and 2015.
- Current marijuana use was not statistically different between 2013 and 2015 for either male or female middle school students in Colorado.
- In both 2013 and 2015, current marijuana use was statistically lower among Asian high school students than among white, Hispanic, black, and multiple or other race students.
- In both 2013 and 2015, current marijuana use was statistically higher among multiple or other race high school students than among white students.
- In 2013, current marijuana use was also statistically higher among Hispanic, black and American Indian/Alaskan Native high school students than among white students.
- In 2013 and 2015, current use of marijuana among students identifying as gay, lesbian or bisexual, was statistically higher than estimated current use among students identifying as heterosexual.
- In 2015, among high school seniors who had used marijuana at least once in the past, an estimated 84.4% of them first used by age 16 or before, 41.3% first used by age 14 or before, and 14.3% first used by age 12 or before.
- Age of first marijuana use followed a similar pattern among high school seniors surveyed in 2013 who reported ever using marijuana.

- In both 2013 and 2015, the estimated percent of white students who first tried marijuana before age 13 was statistically lower than among black, Hispanic, and multiple or other race students.
- In 2013, the estimated percent of Asian students who first tried marijuana before age 13 was statistically lower than among black, Hispanic, American Indian/Alaskan Native and multiple or other race students.
- A large majority of high school students who currently use marijuana report that smoking is their usual method of use, as compared to edibles, vaping or other methods of use. • The percentage of high school students who reported usually using edibles was statistically lower in 2015 compared to 2013.
- In 2015, among high school students currently using marijuana, an estimated 35.8% used it once or twice in the past 30 days, while 26.8% used it 20 or more times.
- Among middle school students currently using marijuana, an estimated 40.3 % used once or twice in the past 30 days and 19.8% used 20 or more times.
- The estimated percent of Colorado high school students using marijuana at each frequency level fluctuated for surveys from 2005 to 2015, with no notable trends.
- In 2013, health statistic regions 7 (Pueblo County, 32.0%), 10 (Montrose, Delta, Gunnison, Ouray, Hinsdale, and San Miguel Counties, 26.7%), 20 (Denver County, 26.6%), 17 (Gilpin, Clear Creek, Park, and Teller Counties, 25.1%), 9 (Dolores, San Juan, Montezuma, La Plata, and Archuleta Counties, 24.6%), and 13 (Lake, Chaffee, Fremont, and Custer Counties, 22.9%), were statistically higher than the 2013 Colorado state estimate of current use among high school students of 19.7%.
- In 2015, health statistics regions 7 (Pueblo County, 30.1%) and 9 (Dolores, San Juan, Montezuma, La Plata, and Archuleta Counties, 26.2%) were statistically higher than the 2015 Colorado state estimate of current use among high school students of 21.2%.
- Current marijuana use in health statistics region 10 (Montrose, Delta, Gunnison, Ouray, Hinsdale, and San Miguel Counties) was statistically lower in 2015 (17.5%) than it was in 2013 (26.7%).
- For all other health statistics regions, current use in 2015 was not statistically different from current use in 2013.

#### **Chapter 4: Pregnancy Risk Assessment Monitoring System (PRAMS) 2014 Survey Results:**

##### **Major Findings:**

- The prevalence of marijuana use before pregnancy among women who recently gave birth was statistically lower than use of tobacco or alcohol before pregnancy.
- The prevalence of alcohol use during pregnancy was statistically higher than use of tobacco or marijuana during pregnancy. The use of marijuana was not statistically different from use of tobacco.
- The prevalence of marijuana use before pregnancy was statistically higher than use during pregnancy or use by breastfeeding mothers after delivery. There was no statistical difference between use during pregnancy and use by breastfeeding mothers after delivery.
- The prevalence of marijuana use during pregnancy was statistically higher among women with an unintended pregnancy than among women who intended to become pregnant.

- The prevalence of marijuana use during pregnancy was statistically higher among women with less than a 12th grade education than among women with some college.
- The prevalence of marijuana use during pregnancy was statistically higher among women 20-24 years old than among women 25-34 years old or women 35 years old or older.
- There were no statistical differences in marijuana use during pregnancy by race/ethnicity.

## **Section 2: Scientific Literature Review on Potential Health Effects of Marijuana Use**

### **Summary of key findings:**

#### **Marijuana use among adolescents and young adults**

The committee 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 impaired learning, memory, math and reading, even 28 days after last use. Weekly use is also associated with failure to graduate from high school. Adolescents and young adults who use marijuana are more likely to experience psychotic symptoms as adults, such as hallucinations, paranoia, delusional beliefs and feeling emotionally unresponsive. Evidence shows marijuana users can become addicted to marijuana and treatment for marijuana addiction can decrease use and dependence. Additionally, marijuana users who quit have lower risks of cognitive and mental health outcomes than those who continue to use.

#### **Marijuana use and cancer**

The committee reviewed different forms of cancer relative to marijuana use, 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. However, there is conflicting research for whether or not a higher cumulative level of marijuana smoking is associated with lung cancer. Limited evidence suggests an association between marijuana use and both testicular and prostate cancers. On the other hand, the limited evidence available concerning cancers of the bladder, head and neck suggests that they might not have any association with marijuana use.

#### **Marijuana use and cardiovascular effects**

The committee reviewed myocardial infarction, stroke and death from cardiovascular causes, relative to marijuana use. There is a moderate level of scientific evidence that marijuana use increases risk for some forms of stroke in individuals younger than 55, and more limited evidence that marijuana use may increase risk for heart attack. Research is lacking concerning other cardiovascular events and conditions, including death.

#### **Marijuana dose and drug interactions**

The committee 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 likely to evolve substantially over coming years. Finally, there is some evidence that opioid pain medication overdose deaths are lower in states with legal medical marijuana than would be expected based on trends in states without legal medical marijuana. There is conflicting evidence for whether or not marijuana use is associated with a decrease in opioid use among chronic pain patients or individuals with a history of problem drug use.

### **Marijuana use and driving**

The committee reviewed driving impairment and motor vehicle crash risk relative to marijuana use, as well as evidence indicating how long it takes for impairment to resolve after marijuana use. It found the risk of a motor vehicle crash increases among drivers with recent marijuana use. Furthermore, the higher the blood THC level, the higher the motor vehicle crash risk. 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, 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 should wait at least six hours after smoking or eight hours after eating or drinking marijuana to allow time for impairment to resolve.

### **Marijuana use and gastrointestinal or reproductive effects**

The committee reviewed gastrointestinal diseases, particularly cyclic vomiting, and infertility or abnormal reproductive function. Evidence shows that long-time, daily or near daily marijuana use is associated with cyclic vomiting. This condition has been called cannabinoid hyperemesis syndrome. In such cases, stopping marijuana use may relieve the vomiting. There is conflicting research for whether or not marijuana use is associated with male infertility or abnormal reproductive function, and research is lacking on female reproductive function related to marijuana use.

### **Marijuana use and injury**

The committee 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 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, 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 and neurological, cognitive and mental health effects**

The committee reviewed the potential relationships between marijuana use and cognitive impairment, mental health disorders and substance abuse. Strong evidence shows that daily or near daily marijuana users are more likely to have impaired memory lasting a week or more after quitting. An important acute effect of THC is psychotic symptoms, such as hallucinations,

paranoia and delusional beliefs during intoxication. These symptoms are worse with higher doses. Daily or near daily marijuana use is associated with developing a psychotic disorder such as schizophrenia. Finally, evidence shows marijuana users can become addicted to marijuana and treatment for marijuana addiction can decrease use and dependence.

### **Marijuana use during pregnancy and breastfeeding**

The committee reviewed adverse birth outcomes, effects of prenatal marijuana use on exposed offspring later in childhood or adolescence and effects of marijuana use 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 during pregnancy may be associated with an increased risk of heart defects or stillbirth. Stronger evidence was found for effects that are seen months or years after birth if a child's mother used marijuana while pregnant with the child. These include decreased growth and impaired cognitive function and attention. Decreased academic ability or increased depression symptoms may also occur.

### **Marijuana use and respiratory effects**

The committee 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 and chronic bronchitis. Additionally, daily or near daily marijuana use may be associated with bullous lung disease and pneumothorax in individuals younger than 40 years of age. Research is lacking concerning any possible association between marijuana use and COPD, emphysema or respiratory infections. 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.

### **Unintentional marijuana exposures in children**

The committee 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 the 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.

## **Chapter 1: Systemic Literature Review Process**

### **Rating the findings:**

Findings were rated as a high, medium, or low quality based on the strengths and limitations of the methods. Evaluation of the strengths and limitations was based on criteria in the "GRADE approach to evaluating the quality of evidence." <sup>2</sup> The GRADE system is a well-established method for systematic literature review and has been used by the Cochrane Collaboration, British

**Medical Journal, American College of Physicians, World Health Organization, and many others.**

**High quality:**

The official definition is: “We are very confident that the true effect lies close to that of the estimate of the effect outlined in the study.” High quality findings originate from well-designed and well-controlled studies with few limitations. In the context of observational epidemiology studies, which was the most common study type in this systematic review, high quality does not necessarily imply causation. High quality implies that an observed association persists between an exposure and effect in an appropriately-sized study population after adjusting for the appropriate confounders.

**Medium quality:**

The official definition is: “We are moderately confident in the effect estimate outlined in the study. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.” Moderate quality findings originate from studies that may be well designed, but have limitations that affect the interpretation of the results. In the context of observational epidemiology studies, moderate quality implies the finding of an observed association with an interpretation that may be limited by a small study population or insufficient adjustment for important confounders.

**Low quality:**

The official definition is: “Our confidence in the effect estimate outlined in the study is limited. The true effect may be substantially different from the estimate of the effect.” Low quality findings originate from studies with significant methodological limitations that affect the interpretation of the results. In the context of observational epidemiology studies, low quality implies the finding of an observed association with an interpretation that is significantly restricted by major study limitations.

**Grouping the findings and weighing the evidence:**

Findings from individual studies were grouped together to facilitate weighing the overall scientific evidence. Findings were usually grouped based on outcome (health effect). However, in specific situations, findings could be further subdivided based on factors such as: age group of the exposed population, special subject circumstances such as pregnancy or breastfeeding, level or method of marijuana use, and time period since last use of marijuana.

**Chapter 2: Marijuana Use Among Adolescents and Young Adults:**

**Key findings:**

The committee’s strongest findings are related to reduced cognitive abilities and academic achievement, problem use or addiction‡ to marijuana or other substances after adolescence and experiencing psychotic symptoms or diagnoses. Weekly marijuana use by adolescents is associated with impaired learning, memory, math and reading, even 28 days after last use. Weekly use is also associated with failure to graduate from high school and may be associated with failure to attain a college degree. Adolescents and young adults who use marijuana are more likely to experience psychotic symptoms as adults, such as hallucinations, paranoia, delusional

beliefs and feeling emotionally unresponsive. Daily or near-daily use is associated with developing a psychotic disorder such as schizophrenia in adulthood.

Concerning future substance use, marijuana use among adolescents and young adults is associated with future tobacco and illicit drug use and high-risk use of alcohol. In addition, marijuana users can develop addiction<sup>‡</sup> to marijuana. Strong evidence shows that treatment for marijuana addiction<sup>‡</sup> can decrease use and dependence. Additionally, marijuana users who quit have lower risks of cognitive and mental health outcomes than those who continue to use. Finally, the committee found conflicting evidence regarding the potential effect of adolescent marijuana use on future IQ.

An important note for all key findings is that the available research evaluated the association between marijuana use and potential adverse health outcomes. This association does not prove that the marijuana use 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 was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use. The Retail Marijuana Public Health Advisory Committee 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 committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

### **Chapter 3: Marijuana Use and Cancer:**

#### **Key findings:**

Strong evidence shows that marijuana smoke contains many of the same cancer-causing chemicals found in tobacco smoke. Marijuana smoke from water pipes or bongs may contain more cancer-causing chemicals than smoke from a marijuana joint. On the other hand, marijuana vapor may contain fewer cancer-causing chemicals than smoke from a marijuana joint.

Most lung cancer studies have used the concept of “joint-years” as a measure of total cumulative marijuana smoking. A “joint-year” is the equivalent of smoking one joint per day for a year. Levels of cumulative use in these studies tended to divide into people who have smoked more than 10 joint years and people who have smoked fewer than 10 joint years. There is conflicting research for whether or not smoking more than 10 joint-years is associated with lung cancer. For those who have smoked fewer than 10 joint-years, an association appears unlikely.

Limited evidence suggests an association between marijuana use and both testicular (no seminoma) and prostate cancers. On the other hand, the limited evidence available concerning cancers of the bladder, head and neck suggests that they might not have any association with marijuana use.

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were not identified. In addition, marijuana use was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use. The Retail Marijuana Public Health Advisory Committee 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 committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

#### **Chapter 4: Marijuana Use and Cardiovascular Effects**

##### **Key findings:**

There is a moderate level of scientific evidence that marijuana use increases risk for some forms of stroke in individuals younger than age 55 years, and more limited evidence that marijuana use may increase risk for heart attack. Research is lacking for other cardiovascular events and conditions, including death.

An important note for all key findings is that the available research evaluated the association between marijuana use and potential adverse health outcomes. This association does not prove that the marijuana use 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 was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use. The Retail Marijuana Public Health Advisory Committee 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 committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

#### **Chapter 5: Marijuana Dose and Drug Interactions**

##### **Key findings:**

Multiple studies have measured blood THC levels following marijuana 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. This has important implications for the time to wait between doses or prior to safety-sensitive activities like driving. Smoking or vaporizing more than 10mg THC, or consuming an edible marijuana product with more than 15mg THC can lead to a blood THC level above 5ng/mL, which can be used to support a conviction for driving under the influence.

Regarding secondhand marijuana exposure, evidence shows that individuals passively exposed under usual conditions would not test above standard cutoffs for marijuana on a

workplace urine test or driving impairment blood test. There is some evidence that secondhand exposure under extreme conditions can cause psychomotor impairment and increased heart rate.

Much has been said about the relationship between marijuana use and opioid use, but research remains limited. There is some evidence that opioid analgesic overdose deaths are lower in states with legal medical marijuana than would be expected based on trends in states without legal medical marijuana. There is conflicting evidence for whether or not marijuana use is associated with a decrease in opioid use among chronic pain patients or individuals with a history of problem drug use.

Clinical and pharmacokinetic data about potential drug-drug interactions with marijuana are currently lacking for many drugs and are likely to evolve substantially over coming years. There is credible evidence of clinically important drug-drug interactions with marijuana including the following: chlorpromazine, clobazam, clozapine, CNS depressants (e.g. barbiturates, benzodiazepines), disulfiram, hexobarbital, hydrocortisone, ketoconazole, MAO inhibitors, phenytoin, protease inhibitors (indinavir, nelfinavir), theophylline, tricyclic antidepressants and warfarin (see Table 2 for additional details). The lack of a cited interaction with other medications does not preclude the possibility that drug interactions exist; it simply means no studies have yet reported an interaction with that particular drug.

An important note for all key findings is that the available research evaluated the association between marijuana use and potential adverse health outcomes. This association does not prove that the marijuana use 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 was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use. The Retail Marijuana Public Health Advisory Committee 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 committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

## **Chapter 6: Marijuana Use and Driving**

### **Key findings:**

The committee found that the risk of a motor vehicle crash increases among drivers with recent marijuana use. Furthermore, the higher the blood THC level, the higher the motor vehicle crash risk. In addition, using alcohol and marijuana together increases impairment and the risk of a motor vehicle crash even more than using either substance alone. For less-than-weekly marijuana users, 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. This applies to smoking, eating, or drinking the marijuana or marijuana product. Waiting at least six hours after smoking marijuana containing less than 35 milligrams of THC likely will allow sufficient time for the impairment to resolve among less-than weekly users. The waiting time is longer for

eating or drinking marijuana products. It is necessary for marijuana users who use it less-than-weekly to wait at least eight hours for impairment to resolve after eating or drinking less than 18 milligrams of THC. Data on doses that cause impairment and time for impairment to resolve is lacking for frequent marijuana users.

An important note for all key findings is that the available research evaluated the association between marijuana use and potential adverse health outcomes. This association does not prove that the marijuana use 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 was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use. The Retail Marijuana Public Health Advisory Committee 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 committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.