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The Highs and Lows of Conducting Research on Cannabis in Washington State

A Summary of the 11th Annual Symposium
September 13, 2018

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Preface

On November 6, 2012, the voters of Washington State, by a margin of 56 to 44 percent, passed Initiative 502, which legalized the sale, possession, and private use of small amounts of marijuana for adults ages 21 and over.¹ I-502 has created a major industry in Washington, with sales of cannabis products exceeding \$900 million in 2017. It also has created an unprecedented opportunity to learn more about the effects of cannabis use on individuals and society and to develop public policies that maximize the benefits of legalization while minimizing the harms.

I-502 created a Dedicated Marijuana Fund consisting of all the excise taxes, license fees, and other revenues from marijuana-related activities. It then earmarked most of these funds for prevention, education, health, and research. However, the regulatory environment has made it difficult for researchers studying cannabis in Washington State to be as productive and effective as they could be.

Recognizing the potential of research to inform the many public and private decisions being made about cannabis, the Washington State Academy of Sciences decided to devote the symposium portion of its 11th Annual Meeting to cannabis research in Washington State. The symposium looked at two broad topics: research into the effects of cannabis on individuals and on society (summarized in Chapter 2 of this report), and the regulatory measures that both advance and hinder research (summarized in Chapter 3). However, even more than with other prominent public policy issues, regulation and research are intertwined for cannabis. Cannabis legalization is so new that many unknowns surround how legalization should proceed and what its effect might be. At the same time, regulation has a profound influence on what research can be undertaken and how that research can be done. While the presentations at the symposium tended to focus on either research or regulation, the speakers often alluded to the many ways in which they interconnect.

The symposium, held on September 13, 2018, was organized by WSAS's Quality of Life, Health, Education and Workforce Preparedness Topical Working Group. Donna Gerardi Riordan, Devon Emily Thorsell, and Bethany Fruci organized the annual meeting symposium. Steve Olson wrote the symposium summary.

By providing a venue for the presentation of empirical evidence and discussions of possible routes forward,

the Washington State Academy of Sciences hopes to help educate researchers, policy makers, and the public about the challenges and opportunities posed by cannabis legalization. Cannabis legalization in Washington and other states is in essence a massive experiment that will affect the lives of millions of individuals. We owe it to ourselves and our children to learn as much from this experiment as we can.

- John Roll, Chair of the Symposium. Washington State University, Professor and Vice Dean for Research, Elson S. Floyd College of Medicine, Associate Vice Dean for Health Sciences Research

¹ The text of the initiative is available at <https://www.sos.wa.gov/assets/elections/initiatives/i502.pdf>.

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1. Cannabis: An Introduction

Cannabis has been a part of human societies for more than 10,000 years, observed John Roll, professor and vice dean for research in the Elson S. Floyd College of Medicine at Washington State University, in his introduction to the 11th Annual Symposium of the Washington State Academy of Sciences. It has been a source of fiber, food, fodder for livestock, and chemical products. It has served as a medical treatment for many maladies. It has provided a spiritual or recreational means of altering a person's conscious experiences. Its wide-ranging uses and effects have helped make cannabis a focus of societal interest, discussion, and controversy. Cannabis "has been revered and vilified, cultivated and destroyed, used to produce hope and used as a way to perpetuate discrimination — often all at the same time," Roll said.

THE EFFECTS OF CANNABIS ON THE HUMAN BODY

Cannabis comes from a group of flowering plants that are often divided into three species — *Cannabis sativa*, *Cannabis indica*, and *Cannabis ruderalis* — though sometimes these species are considered subspecies of a single species. Cannabis plants produce more than a hundred different phytocannabinoids, most of which have received very little in-depth study. The main psychoactive compound in cannabis is tetrahydrocannabinol (THC); another important phytocannabinoid is cannabidiol (CBD), which has effects quite different than those of THC. A class of synthetic cannabinoids have chemical structures similar to those of the phytocannabinoids and a comparably broad range of effects.

People smoke, vaporize and inhale, and eat cannabis. When smoked, THC and other cannabinoids rapidly move from the lungs into the bloodstream where they enter the brain and exert their primary effects. When eaten, the effects of cannabis intensify more slowly and last longer. The cannabinoids are hydrophobic, which means that they tend to move toward fat tissues and have a different behavior than drugs like nicotine or alcohol.

THC interacts with receptors in the brain that interact with endogenous chemicals that resemble the phytocannabinoids (Figure 1-1). These receptors occur throughout the brain, including in the neocortex, basal ganglia, nucleus accumbens, hypothalamus, amygdala,

hippocampus, cerebellum, brain stem, and spinal cord. They also occur elsewhere in the body, including the immune, digestive, and nervous systems.

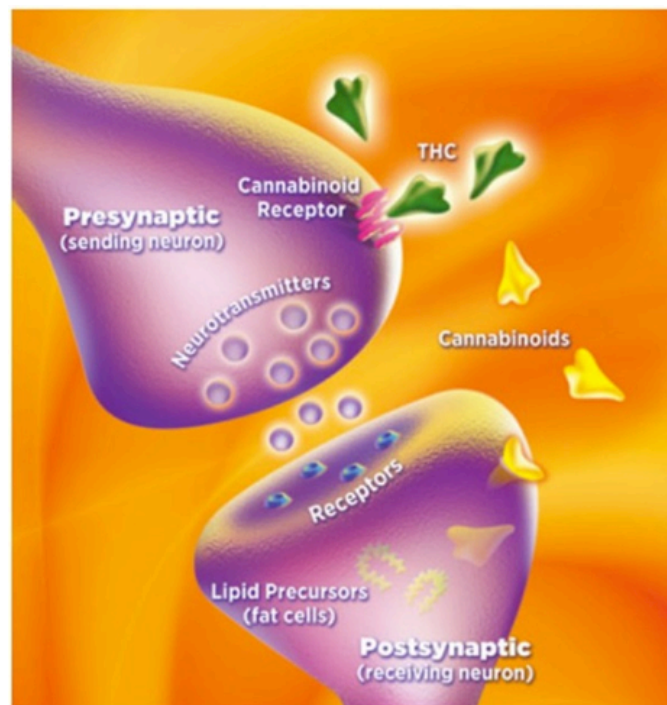


FIGURE 1-1 THC and other cannabinoids from cannabis (shown in green) interact with receptors for endogenous cannabinoids (shown in yellow) in the brain and elsewhere, producing a wide range of biological effects.

Short-term effects of cannabis consumption can include seeing brighter colors, an altered sense of time, changes in mood, impaired body movement, difficulty with thinking and problem solving, and impaired memory. When cannabis is taken in very high doses, hallucinations, delusions, and psychosis can result.

Long-term effects are dose dependent and may include changes in brain development, especially when use begins during adolescence. These changes may cause impaired thinking, memory, and learning. Other health impacts include breathing problems, which are usually related to smoking cannabis, transient increased heart rate, temporary hallucinations, nausea, vomiting, and temporary paranoia. On average, regular users report lower life satisfaction, poorer mental health, poorer physical health, and more relationship problems, though cannabis does not necessarily cause these problems.

Cannabis can be addictive, and users of cannabis

can develop substance use disorders. These disorders can be treated with psychotherapy, behavioral therapy, and other interventions. Withdrawal from cannabis is characterized by irritability, sleeplessness, decreased appetite, anxiety, and cravings.

Cannabis also has the potential to yield health benefits. Most efforts to understand the health benefits of cannabis focus on THC and CBD, although others are being studied. The Food and Drug Administration has approved drugs that include cannabinoids to treat chemotherapy-induced nausea and anorexia associated with AIDS and cancer and certain forms of epilepsy.

In 2017 a committee of the National Academies of Sciences, Engineering, and Medicine released a report on the health effects of cannabis and cannabis-derived products.² The report found that cannabis may be useful in the treatment of chronic pain, muscle spasm related to multiple sclerosis, and chemotherapy-induced nausea and vomiting. As risks, it identified motor vehicle accidents, degradation of memory and learning, and overdose injuries among children. Pregnant women who use the drug have lower birthweights, the report noted, though the nature of this association is unclear.

THE ECONOMIC EFFECTS OF CANNABIS LEGALIZATION

As of September 2018, cannabis was legal for medical uses in 30 states and the District of Columbia, and cannabis was legal for recreational purposes in 9 of those states. In his introduction to the symposium, Roll noted that legalization has been having major economic implications for cities and states. Forbes has reported that cannabis legalization added \$58 million to the local economy of Pueblo, Colorado, though this was partially offset by \$23 million in costs incurred primarily by law enforcement and social services.³ Business Insider has predicted that the legal marijuana industry in California could reach \$6.45 billion by 2020.⁴ By 2021, observed Dan Nordquist, associate vice president for research support and operations at Washington State University, cannabis could be a \$40 billion industry in the United States and responsible for

2 National Academies of Sciences, Engineering, and Medicine. 2017. *The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research*. Washington, DC: The National Academies Press.

3 Zhang, M. 2018. Legal marijuana is a boon to the economy, study says. *Forbes*, March 13.

4 Gilbert, B. 2016. California's legal marijuana market is on the verge of exploding. *Business Insider*, September 21.

nearly half a million jobs.⁵

Through fiscal year 2018, Washington State had collected more than \$900 million in excise taxes from cannabis sales (Figure 1-2). In FY 2018 alone, it collected \$357.8 million on total sales of \$1.6 billion. Washington State has about 450 retailers and about 1,000 processors and producers (Figure 1-3). "There is serious money involved," said Roll. "This is big business."

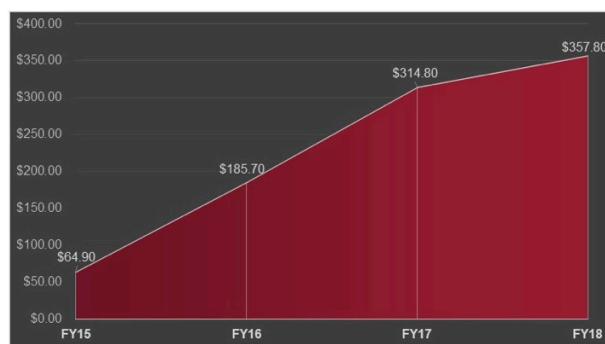


FIGURE 1-2 Since cannabis sales were legalized in Washington State, tax receipts have steadily risen. Source: Washington State Liquor and Cannabis Board.



FIGURE 1-3 Almost every county in Washington State has cannabis retail locations and cannabis producers and processors. Source: Mikhail Carpenter, Washington State Liquor and Cannabis Board.

5 Conley, K. 2018. Cannabis industry projected to generate \$40 billion in 2021. *Dope*, January 29.

With approximately one-seventh of its economy based on agriculture, Washington State is in a position to benefit financially from the continued expansion of the cannabis industry. And, said Roll, “as a longtime resident of the state, I have seen firsthand how that kind of economic growth benefits the citizenry.”

QUESTIONS SURROUNDING RESEARCH AND REGULATION

Beyond the economic and social effects of cannabis legalization, observed Roll, critical questions remain: Does cannabis help people? Does it hurt them? Or, as with drugs like alcohol, nicotine, and opioids, does it do both?

Well-intentioned people on both sides of the debate make legitimate arguments, and their opinions should be respected, Roll said. But the regulation of cannabis, like the regulation of other drugs, needs to be based on science — while recognizing that when someone is desperate for medical help, the level of evidence they require to form an opinion may be lowered.

The 11th Annual Symposium of the Washington State Academy of Sciences addressed two major issues surrounding cannabis. What research needs to be done to learn more about cannabis and its effects on individuals and society (Chapter 2)? And what are the regulatory barriers that make it difficult to conduct the science needed to answer important questions about cannabis (Chapter 3)? The symposium also provided an opportunity to draw important messages from the presentations and discussions of the symposium participants (Chapter 4).

2. Research on Cannabis

Cannabis research is remarkably wide ranging. In his overview of cannabis research and regulation, Nordquist listed several broad research areas and examples of research questions within each:

Health Research

- Treatments for pain, seizures, nausea, and other conditions
- Effects on appetite, glaucoma, and sleep disorders
- Risks to health such as cancer, lung disease, psychological effects, and impairment
- Health effects on people who work in the industry

Agriculture and the Environment

- Cultivation issues
- Industrial hemp
- Water and energy management
- Pest/weed control
- Environmental impacts

Basic Research

- Genetics and differences among strains
- Molecular structure and function of cannabinoids and receptors

Social Science and Policy

- Demographics of use
- Effects of marketing
- Economic impact
- Industry structure
- Legal questions

Testing

- THC content
- Pesticides
- Contaminants

States have particular research needs that are dictated by their circumstances, Nordquist added. For example, the research priorities of the Washington State Liquor and Cannabis Board are:

- Product potency
- Advertising and labeling that is especially appealing to children
- Perceived risks and youth consumption
- Taxes and pricing
- Effects of advertising

As an example of this research, Nordquist cited a survey done by Washington State University researchers to determine if living near marijuana dispensaries and viewing cannabis advertisements were associated with the

intentions of young people to use marijuana.

Initiative 502 directed that one percent of state revenues should be used to support research at the University of Washington and Washington State University on the short- and long-term effects of marijuana use, including formal and informal methods for estimating and measuring intoxication and impairment (Figure 2-1). However, the state legislature has decided to use most of those tax funds for other purposes, Nordquist observed. One percent of the state's cannabis revenues would have amounted to more than \$3 million in 2017 alone. However, Washington State University received only \$268,000 for research in 2016 and 2017 combined. Meanwhile, Colorado funded \$9 million of research through the Colorado Department of Public Health and Environment from 2015 through 2017, and \$10 million per year of revenues from cannabis sales in California are expected to go to research.

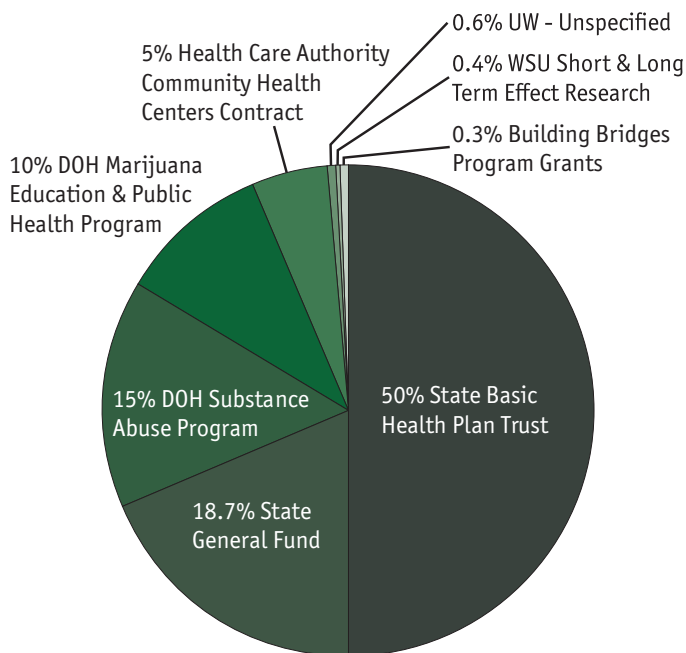


FIGURE 2-1 Washington Initiative 502 earmarks revenues above those required for administrative purposes for general public health, drug-abuse treatment, drug-abuse prevention, and marijuana research and local facilities at the University of Washington and Washington State University.

As Roll noted in his presentation, "We have a unique opportunity to add scientific rigor to our understanding of the relationship between humanity and cannabis," and increased funding from the legislature could enable Washington State to be a leader in this research.

“We are at a confluence of history, technology, economics, and politics, in a moment when we can bring the power of science to bear to help understand what the true nature of the relationship between humanity and cannabis is and what the potential of that relationship might be.”

THE CONSEQUENCES OF LEGALIZATION

Initiative 502 included provisions to survey young people in Washington State to monitor the effects of legalization on their cannabis use, attitudes, health, and other indicators. These and other survey results demonstrate that “the sky has not fallen — at least not yet,” said Kevin Haggerty, endowed associate professor in prevention in the School of Social Work and director of the Social Development Research Group at the University of Washington, who reviewed several key areas of social science research in his presentation. The number of adolescents who report using marijuana at some point in the past and at some point in the last 30 days either declined or stayed level after cannabis legalization (Figure 2-2). Adolescents also report that cannabis has been slightly harder to obtain after legalization, and the percentages of adolescents who believe that regular use of cannabis is harmful or very harmful have stayed the same or have risen slightly in the sixth, eighth, and tenth grades while falling slightly in the twelfth grade.⁶

However, these trends need to be viewed in a broader context, Haggerty pointed out. The percentages of high school seniors using alcohol, cigarettes, and e-cigarettes in the past 30 days have generally fallen in the past three decades, while the percentage using cannabis has increased (Figure 2-3). Moreover, people who have used cannabis in the past are now using cannabis more often,⁷ and daily use among young people one to four years out of high school who are not going to college has risen dramatically.⁸ Both are indications of increased rates of problem use, said Haggerty. “This is an important area for us to focus prevention efforts on.”

6 Darnell, A. J., and K. Bitney. 2017. *I-502 Evaluation and Benefit-Cost Analysis: Second Required Report*. Olympia: Washington State Institute for Public Policy.

7 Kosterman, R., J. A. Bailey, K. Guttmanova, T. M. Jones, N. Eisenberg, K. G. Hill, and J. D. Hawkins. 2016. Marijuana legalization and parents’ attitudes, use, and parenting in Washington State. *Journal of Adolescent Health* 59(4):450–456.

8 Schulenberg, J. E., L. D. Johnston, P. M. O’Malley, J. G. Bachman, R. A. Miech, and M. E. Patrick. 2018. *Monitoring the Future National Survey Results on Drug Use, 1975–2017: Volume II, College Students and Adults Ages 19–55*. Ann Arbor: Institute for Social Research, The University of Michigan.

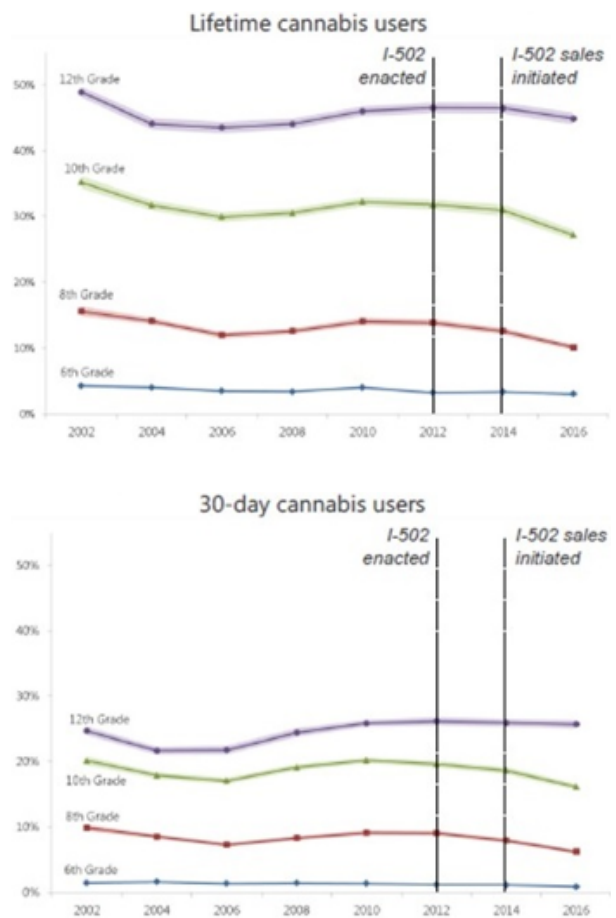


FIGURE 2-2 The percentages of adolescents using cannabis in Washington State have stayed the same or have declined since legalization. Source: Darnell, A. J., and K. Bitney. 2017. *I-502 Evaluation and Benefit-Cost Analysis: Second Required Report*. Olympia: Washington State Institute for Public Policy.

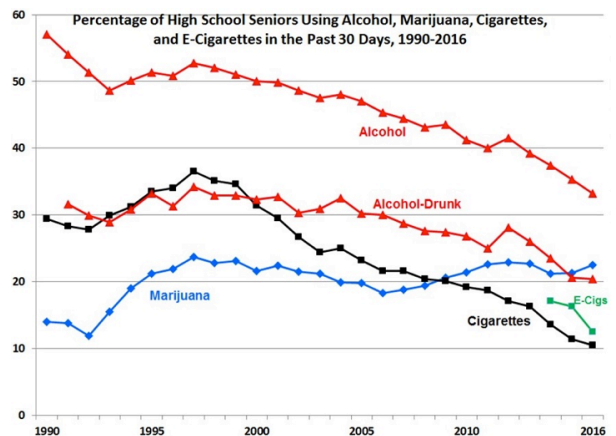


FIGURE 2-3 The percentages of high school seniors using alcohol, marijuana, cigarettes and e-cigarettes in the past 30 days have declined in recent decades, but the percentage using marijuana has increased. Source: Johnston, L. D., R. A. Miech, P. M. O’Malley, J. G. Bachman, J. E. Schulenberg, and M. E. Patrick. 2018. *Monitoring the Future National Survey Results on Drug Use: 1975–2017: Overview, Key Findings on Adolescent Drug Use*. Ann Arbor: Institute for Social Research, The University of Michigan.

Another area of concern is the very high THC levels in cannabis, a point also mentioned by several of the other presenters. In the 1970s, when cannabis use was common among high school students, THC levels were typically 3 to 5 percent, said Haggerty. They are now often above 20 percent. “We have a different substance now than we had in 1976. We don’t know what the consequences of that high level are.” For example, what are the effects on a six-year-old of a parent who is using very strong cannabis on a daily basis? What are the effects of moderate use, such as once a week? Possible targets for research would be to examine the impact of high THC levels on young people and the implications of regulating THC levels in cannabis products.

Haggerty pointed to the importance of caregivers among the risk factors for adolescent cannabis use. A family history of problem behavior, family management problems, family conflict, and favorable parental attitudes and involvement toward the problem behavior are all risk factors for youth marijuana use.⁹ In addition, peer or sibling use, prior alcohol use, and prior cigarette use all increase the likelihood for marijuana use, according to work done at the Social Development Research Group. Children who perceive their parents as having favorable attitudes toward drug use were five times more likely to have tried marijuana by eighth grade and six times more likely to be a frequent user by tenth grade.¹⁰ In contrast, good family management, norms against use, and perceived harm all lower the likelihood of marijuana initiation. The Social Development Research Group has partnered with Seattle Children’s Hospital to produce *A Parent’s Guide to Preventing Underage Marijuana Use*, which calls for clear and specific guidelines, monitoring, and the need for consequences and problem solving to reduce marijuana use among adolescents.¹¹

Programs to prevent marijuana use among youth need to be based on the best available evidence, said Haggerty. As an example, he cited the publication *Programs and Practices for Youth Marijuana Use Prevention*, which lists 19 evidence-based approaches and 5 promising approaches.¹² “We need to make sure that those programs are

being well implemented in Washington State,” he said. In addition, evidence-based programs tested prior to legalization may work differently in a legal context, he noted. Innovative studies such as staggered start-dates for programs could provide valuable information on the outcome of a program in a legalized context.

Finally, public health messaging is critical, Haggerty said, and these messages need to be tailored to the people receiving them. For example, research has shown that parents appreciate receiving information about the law, since their knowledge levels are still low.¹³ (Two to three years after the law was passed, 25 to 33 percent of parents of adolescents still did not know the legal age of cannabis use in Washington State). Public campaigns such as “Listen2YourSelfie” and “You Can” have sought to educate Washington adolescents about the health effects and consequences of cannabis. Harm reduction messages that emphasize the moderate use of legal cannabis are particularly important, Haggerty observed. Unlike alcohol, for which “one and done” types of approaches are available, no messaging exists on acceptable, normative, or moderate use of cannabis. “We need a threshold to help people understand when too much is too much and when it causes harm.” A particular need is for messages that help people understand the timeframe between use and driving. These messages inevitably will be more complicated than for alcohol, since they depend on how much THC people have absorbed and their prior cannabis use.

Like Nordquist, Haggerty pointed to the potential of funding from cannabis legalization to address these and other pressing research needs. “We need to continue to advocate for prevention dollars going to prevention, and for money to go to research,” said Haggerty. Researchers have very high esteem with legislators, he pointed out. They can have “a strong voice in letting [legislators] know that we need the prevention money and we need the research funds to help answer questions that we don’t know.”

OPTIMIZING THE MEDICAL PROPERTIES OF CANNABIS

Nephi Stella, professor of pharmacology and psychiatry and behavioral sciences at the University of Wash-

available at <https://www.dshs.wa.gov/sites/default/files/SESA/publications/documents/22-1661.pdf>.

¹³ Hanson, K., K. P. Haggerty, C. B. Fleming, M. L. Skinner, M. Casey-Goldstein, W. A. Mason, and C. Redmond. 2018. Washington State retail marijuana legalization: parent and adolescent preferences for marijuana messages in a sample of low-income families. *Journal of Studies on Alcohol and Drugs* 79(2):309-317.

⁹ Sabet, K. E., and K. C. Winters, eds. 2018. *Contemporary Health Issues on Marijuana*. New York: Oxford University Press.

¹⁰ Catalano, R. F., E. C. Speaker, M. L. Skinner, J. A. Bailey, G. Hong, K. P. Haggerty, K. Guttmanova, and E. N. Harrop. 2018. Risk factors for adolescent marijuana use. In K. C. Winters and K. A. Sabet, eds., *Contemporary Health Issues on Marijuana*. New York: Oxford University Press, 219-235.

¹¹ *A Parent’s Guide to Preventing Underage Marijuana Use* is available at <http://learnaboutmarijuanawa.org/parentpreventionbooklet2014.pdf>.

¹² *Programs and Practices for Youth Marijuana Use Prevention* is

ington, described the work he has done to help develop cannabinoid-based medicines — and specifically better treatments for epilepsy and cancer. Cannabis is a “fascinating plant,” he said. It has very large DNA molecules and a wide variety of phenotypes, from small plants to voluptuous bushes. THC, CBD, and other cannabinoids interact with receptors that occur in many parts of the body and regulate multiple physiological functions, with differing effects from person to person.

Much remains unknown about the biology of the plant, its chemical products, and their effects on the body. Many strains with exotic names are for sale in the cannabis marketplace, but the strains and their chemical compositions are not well defined or understood. People say that “this strain will make me more sleepy, this strain will make me more energetic,” Stella pointed out. “Those are fascinating stories and we’re listening to them, but we still can’t unlock the code.” Many cannabinoid receptors exist in the brain, and the mechanism of action on neurons has been studied in recent decades, but much more needs to be learned. Compared with the millions of scientific papers on such plants as tomatoes or apples, the number of scientific papers on cannabis plants is tiny. “There’s so much research to be done.”

Stella’s goal is to move all the way from basic research on the pharmacodynamics and pharmacokinetics of cannabinoids to human trials. His laboratory at the University of Washington has had a Schedule 1 license to conduct cannabis research for almost two decades. It was the first such license at the University of Washington and the only one until 2012. As of 2018, five laboratories at the university had such licenses, three in the medical school and two in the pharmacy school.

Stella emphasized the idea of the therapeutic index — the range between the dose of cannabinoids that has a therapeutic effect and the dose that has a toxic effect. The goal, he said, is to have a large therapeutic index to provide maximal benefits and minimal side effects. However, much is still not known about the pharmacokinetics of different cannabinoids, methods of intake, and how the therapeutic index of different cannabinoids changes with the age of a patient. On this last point, for example, the therapeutic index appears to be narrower early in life and wider later in life. CBD also appears to have fewer toxic effects than THC, which is another factor in the therapeutic index.

Foundational studies in rodents have shown that cannabinoids affect the frequency of seizures, and these findings have contributed to cannabis use by epilepsy patients. A well-known example from Colorado involves a young girl whose rate of epileptic seizures dropped from

more than 100 per week to just two or three after she began taking CBD. An open-label interventional trial led to approval by the Food and Drug Administration of an anti-epilepsy drug known as Epidiolex in June 25, 2018, which work in Stella’s laboratory with a mouse model of epilepsy confirmed. Specifically, in the mouse model of epilepsy, both acute and prolonged dosing with CBD reduced seizures.¹⁴ Extensions of this work have the potential to transform medical treatments of epilepsy, said Stella. “This is a life-saving result.”

An interesting aspect of the work in Stella’s lab is that the mice bred to have a seizure syndrome eventually develop autism-like behaviors, and acute administration of CBD reduced these behaviors. “We don’t understand how this works,” he said, but it provides “an opportunity to optimize this therapeutic approach.” His lab has also discovered an enzyme that regulates levels of endogenous cannabinoids, and by blocking the enzyme he and his colleagues have been able to reduce seizures.¹⁵ Another possibility is to chemically modify cannabinoids to optimize their benefits. “This is an exciting technology that we’re trying to move forward,” he said. The cannabinoids and related molecules could produce “a new arm of medicine, because they hit a lot of diseases that don’t have any medical treatments available.”

Given the variety of departments at the University of Washington that are interested in the potential benefits of cannabis research, the university has formed the Center for Cannabis Research to foster innovation and solidify the research being done. “We’ve decided to organize our efforts instead of everybody spinning their wheels independently,” he said. The university is also working with the legislature, with Washington State University, and with other states to become what Stella called “a model of innovation.”

“Cannabinoid research could be our forte,” he concluded. “Cannabis legalization is changing our world quickly. We need to make sure that we receive maximum benefits and minimal side effects.”

14 Kaplan, J. S., N. Stella, W. A. Catterall, and R. E. Westenbroek. 2017. Cannabidiol attenuates seizures and social deficits in a mouse model of Dravet syndrome. *Proceedings of the National Academy of Sciences* 114(42):11229-11234.

15 Naydenov, A. V., E. A. Horne, C. S. Cheah, K. Swinney, K. L. Hsu, J. K. Cao, W. Marrs, J. L. Blankman, S. Tu, A. E. Cherry, S. Fung, A. Wen, W. Li, M. S. Saporito, D. E. Selley, B. F. Cravatt, J. C. Oakley, and N. Stella. 2014. ABHD6 blockade exerts antiepileptic activity in PTZ-induced seizures and in spontaneous seizures in R6/2 mice. *Neuron* 83(2):361-371.

CANNABIS AND MENTAL HEALTH

Cannabis use and mental illnesses are both developmental phenomena that often begin in adolescence, observed Michael McDonell, associate professor and chair of the Committee for Cannabis Research and Outreach in the Elson S. Floyd College of Medicine at Washington State University. During this period, mental functions such as impulse control, risk taking, executive function, and emotional regulation are still developing, and these functions are important both to mental illness and to misusing a substance like cannabis.

Of the approximately 2.4 million people who start using cannabis in a given year, about 80 percent are ages 12 to 20.¹⁶ In addition, daily marijuana use has more than tripled in the past two decades among college students. In Washington State, according to 2015 data from the Substance Use and Mental Health Services Administration, almost 60 percent of marijuana users admitted into substance abuse treatment are these ages. Marijuana is the second most treated illicit substance behind heroin, and adolescents and young adults represent a large portion of the at-risk population for marijuana usage.

In terms of mental illness, about one young person in five is living with a mental health problem of some kind, and 75 percent of all lifetime cases of mental illness begin by age 24.¹⁷ Among people with schizophrenia, about 27 percent have had a cannabis use disorder, compared with just 6 percent of people among the general population.¹⁸ In a large trial of about 450 young people who had had their first episode of psychosis, which has been a particular focus of the National Institutes of Health, about 50 percent of youth were smoking cigarettes when they entered the trial, 28 percent were using alcohol, and 24 percent were using cannabis in the last month.¹⁹

One question these data suggest is whether can-

16 National Institute on Drug Abuse. 2014. *Drug and Alcohol Use in College-Age Adults in 2014*. Available at <https://www.drugabuse.gov/related-topics/trends-statistics/infographics/drug-alcohol-use-in-college-age-adults-in-2014>.

17 National Institute of Mental Health (2016). *Prevalence of Any Mental Disorder Among Adolescents*. Available at https://www.nimh.nih.gov/health/statistics/mental-illness.shtml#part_155771.

18 Stoner, S. A. 2017. *Effects of Marijuana on Mental Health: Psychotic Disorders*. Alcohol & Drug Abuse Institute, University of Washington. Available at <http://adai.uw.edu/pubs/pdf/2017mjpsychosis.pdf>.

19 O. Oluwoye, M. Monroe-DeVita, E. Burduli, L. Chwastiak, S. McPherson, J. M. McClellan, and M. G. McDonell. 2018. Impact of tobacco, alcohol, and cannabis use on treatment outcomes among patients experiencing first episode psychosis: Data from the national RAISE-ETP study. *Early Intervention in Psychiatry* <https://doi.org/10.1111/eip.12542>.

nabis use increases the risk of mental illness, particularly schizophrenia. The risk of developing psychosis and the severity of psychotic symptoms of those with schizophrenia are directly related to the dosage of THC consumed. The THC content of legal cannabis is very high in the United States, as high as 90 percent. In contrast, the highest THC content in cannabis in the United Kingdom is about 20 percent. While most researchers agree that high THC products are likely to lead to onset of psychosis in those at risk, as well as poor outcomes for those with illnesses like schizophrenia, little research studying the impact of high-THC products has been conducted. More research is needed, McDonell said, to tell how much cannabis a person is using and whether high THC levels are related to the poor mental health outcomes he has observed in his patients.

Research in England, Canada, and most recently the United States has shown that marijuana use in general is a risk factor for developing schizophrenia.²⁰ Heavy cannabis users are four times more likely to develop psychosis.²¹ In the development of a condition like schizophrenia, cannabis use interacts with other risk factors that have been identified over the last 50 years, such as close relatives with the condition, stress, trauma, and environmental factors.²² Research is needed in this area as well, McDonell said, to understand these interactions and how the frequency and patterns of use affect mental health.

A related question is whether cannabis use makes mental illness worse. Research has shown that, in patients with schizophrenia, THC does have a dose-dependent relationship with psychotic symptoms.²³ In addition, cannabis use is associated with increased risk of hospitalizations,²⁴ and in a national treatment study of young people experiencing their first episode of psychosis, cannabis users had significantly higher psychotic symptom scores relative

20 Schizophrenia Commission. 2012. *The Abandoned Illness: A Report by the Schizophrenia Commission*. London: Rethink Mental Illness.

21 Marconi, A., M. Di Forti, C. M. Lewis, R. M. Murray, and E. Vassos. 2016. Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophrenia Bulletin* 42(5):1262-1269.

22 World Health Organization. 2012. *Risks to Mental Health: An Overview of Vulnerabilities and Risk Factors*. Available at http://www.who.int/mental_health/mhgap/risks_to_mental_health_EN_27_08_12.pdf.

23 D'Souza, D. C., E. Perry, L. MacDougall, Y. Ammerman, T. Cooper, Y. T. Wu, G. Braley, R. Gueorquieva, and J. H. Krystal. 2004. The psychotomimetic effects of intravenous delta-9-tetrahydrocannabinol in healthy individuals: implications for psychosis. *Neuropsychopharmacology* 29(8):1558-1572.

24 Colizzi, M., N. Burnett, R. Costa, M. De Agostini, J. Griffin, and S. Bhattacharyya. 2018. Longitudinal assessment of the effect of cannabis use on hospital readmission rates in early psychosis: a 6-year follow-up in an inpatient cohort. *Psychiatry Research* 268:381-387.

to non-cannabis users.²⁵ “The answer seems to be yes — cannabis, and in particular high THC, does seem to make symptoms worse, which is something that I tell patients.”

Finally, a question McDonell is often asked is whether cannabis could be used to treat mental illness. He pointed out that CBD has been shown to have antipsychotic effects in humans.²⁶ This study was done in people who not only were at high risk for developing schizophrenia but also who were not at risk, and the same effect was found in both groups. Such results are promising and may explain why patients report a positive effect of cannabis on their psychiatric symptoms, said McDonell, but considerable additional research, including animal research, will be needed to know whether there are potential targets or drug development pathways to treat schizophrenia.

Washington State has led the nation in thinking about the treatment of co-occurring disorders, such as schizophrenia and cannabis use disorders, and the two major medical universities in Washington State are strong collaborators. But even Washington State has not yet done much work on treating schizophrenia and cannabis use together in adolescents. Furthermore, even though cannabis use is legal in Washington State, “we are still breaking federal law if we touch it, if we hold it, or if we give it to people,” said McDonell. Strong institutional support and research funding are needed to overcome the regulatory barriers to doing cannabis research.

DAILY CANNABIS USE DURING PREGNANCY AND PARENTHOOD

Guidelines from the American College of Obstetricians and Gynecologists state that women should not use cannabis during preconception, pregnancy, and lactation, and the Academy of Breastfeeding Medicine states that breastfeeding mothers should be counseled to reduce or eliminate cannabis use and to avoid exposure to their

25 Kane, J. M., D. G. Robinson, N. R. Schooler, K. T. Mueser, D. L. Penn, R. A. Rosenheck, J. Addington, M. F. Brunette, C. U. Correll, S. E. Estroff, P. Marcy, J. Robinson, P. S. Meyer-Kalos, J. D. Gottlieb, S. M. Glynn, D. W. Lynde, R. Pipes, B. T. Kurian, A. L. Miller, S. T. Azrin, A. B. Goldstein, J. B. Severe, H. Lin, K. J. Sint, M. John, and R. K. Heinssen. 2015. Comprehensive versus usual community care for first-episode psychosis: 2-year outcomes from the NIMH RAISE early treatment program. *American Journal of Psychiatry* 173(4):362-372.

26 Bhattacharyya, S., R. Wilson, E. Appiah-Kusi, A. O’Neill, M. Brammer, J. Perez, R. Murray, P. Allen, M. G. Bossong, and P. McGuire. 2018. Effect of cannabidiol on medial temporal, midbrain, and striatal dysfunction in people at clinical high risk of psychosis: a randomized clinical trial. *JAMA Psychiatry* doi: 10.1001/jamapsychiatry.2018.2309.

infant, since THC remains in breastmilk for up to 30 days. Nevertheless, cannabis use during pregnancy has increased significantly over the last two decades, unlike the use of other substances, even as the potency of THC has increased, said Celestina Barbosa-Leiker, associate dean for research, associate professor, and director of the Program of Excellence in Addictions Research at the Washington State University College of Nursing.

Women who use cannabis while pregnant are at greater risk of stillbirth compared to non-substance users, with a risk on par with that of women who smoke tobacco. Prenatal exposure is related to significant behavioral and emotional consequences in older children, such as impulsivity and hyperactivity, depression, aggression, and inattention. However, the research is mixed, noted Barbosa-Leiker. Not all studies find these associations over time, and it is difficult to separate the impact that cannabis has on these outcomes, especially if the women in the studies are also using alcohol, tobacco, and other substances.

Barbosa-Leiker and her colleagues have been doing research on pregnant women’s perceptions of risk and benefits of cannabis use while pregnant and immediately postpartum. They recruited pregnant and postpartum women who self-reported as using cannabis daily or occasionally. Preliminarily, they had 14 participants, 12 of whom used cannabis daily and 2 of whom used it occasionally. Most of them smoked cannabis, though one participant dabbed from concentrated THC vaporized and inhaled, and one participant consumed edibles. The women tended to stop other kinds of cannabis use when they discovered they were pregnant, because they felt they could control their use better through smoking. The majority smoked about three times a day while pregnant, typically referring to their consumption as being a small bowl or a few hits off a joint three or four times during the day. The women did their best not to consume tobacco, alcohol, or opioids while they were pregnant and expressed a desire for information on foods, for example, that could help them through their pregnancies. The majority were not first-time mothers, so they also were able to provide a postpartum perspective.

The study used a qualitative descriptive methodology with an interview guide that included 12 questions, with the goal of gathering descriptions of events or experiences that depict the perspectives of the participants. After interviewing six or seven participants, the researchers began to hear the same stories from the women. They now intend to provide these stories to other pregnant women who use cannabis to verify that they have captured the main messages correctly. The interviews lasted 30 to

60 minutes, and the women received a \$50 gift card to a popular chain store for their participation. This study is ongoing, and Barbosa-Leiker presented only preliminary results. Concurrently, the researchers conducted qualitative interviews with health care providers on their perspectives of benefits and harms to pregnant or postpartum women of cannabis use.

The researchers identified five preliminary themes from the interviews, Barbosa-Leiker reported:

- *Use for medicinal purposes.* All the participants talked about taking care of themselves and their babies. They stated that they were using cannabis for medicinal reasons, such as to reduce morning sickness and nausea, gain the appropriate amount of weight, manage either chronic pain or the aches and pains of pregnancy, lessen anxiety and stress, and get a better night's sleep.
- *Moderate use.* All of the participants said that they were using cannabis in moderation during pregnancy. They had cut back from previous use or were using safer methods — for example, they were not using butane. They expressed concern about pesticides in the cannabis, and some wanted to grow their own so as to avoid pesticides. They saw cannabis as a safer alternative to opioids, nonsteroidal anti-inflammatory drugs, anti-nausea medicines, and other medications. They compared their use of cannabis to their consumption of fast food or caffeine and distinguished cannabis from cigarettes or alcohol.
- *Mixed messages from health care providers.* The women said that they receive a spectrum of information from their health care providers, from “you should stop, it’s like cocaine or heroin” to “you should cut back” to “I also used when I was pregnant.” They contrasted this information with their own experiences, concluding that if health care providers told them things that do not see in their own lives they are unlikely to act on that advice. The women described the stigma they felt when they self-reported cannabis use, and they had legal fears — for example, of Child Protective Services.
- *Wanting more information.* All the research participants were frustrated over the lack of research. They had done their own research, had conducted their own literature reviews, or relied on budtenders for scientific and medical information and guidance on what product to use.
- *Individuality.* The participants engaged in a spectrum of cannabis use while pregnant and postpartum. They also had histories of trauma, homelessness, and co-

morbid conditions such as depression, bipolarity, and fibromyalgia.

The need for more research is obvious and is recognized even by the people they interviewed, who often expressed a need for information that research could provide. A major research question is why women are using cannabis. The women they interviewed were not using cannabis just for fun — “we didn’t hear that, not once.” They were concerned about taking care of themselves and their babies. At the same time, the women’s expectations may be misplaced, Barbosa-Leiker noted. Pregnancy can cause aches and pains, whereas if they were using pain medicine before they began using cannabis their situations may be different.

Researchers also need to be aware of their own biases in conducting these studies, Barbosa-Leiker said. Participants can face significant social stigma, yet some of them are proud of their use or their work in the industry. “We have to be careful that we’re not putting our own stigma onto our participants.” In addition, she pointed out that many substance use studies involve men who are using illegal drugs, but the studies rarely ask if they are fathers. Yet researchers typically have to document that cannabis use among women does not amount to child abuse.

Finally, Institutional Review Boards need to be realistic in reviewing this research, she said. Human subjects need to be protected while removing barriers for observational research with pregnant and postpartum women.

MEASURING CANNABIS IMPAIRMENT

Brian Clowers, associate professor of chemistry at Washington State University, has been working with Nicholas Lovrich, Regents’ Professor Emeritus at the university, on projects associated with the rapid detection of active cannabis consumption. Law enforcement requires a fast and reliable method for roadside detection of THC in the human body, both for prevention and deterrence. In addition, employers need workplace compliance drug testing and point-of-care diagnostics.

However, no validated methods currently exist for the rapid detection of THC in field settings that are operationally feasible, he noted. Currently available tests take at least 10 to 15 minutes, are not able to detect synthetic cannabinoids, are expensive, and pose civil liberty questions in their collection of saliva or other biological samples. The current field detection approach uses one

to two minutes of continuous breath delivery to capture material at room temperature onto a porous absorbent. A flash heating cartridge that is compatible with roadside detection permits the detection of particular compounds, including THC. Another approach is to sample saliva using a hydrophobic swab, with rapid drying and desorption from the swab into a detector. However, even these technologies pose a range of engineering challenges.

In the study described by Clowers, about 50 volunteers, who were compensated for their time, used cannabis and then engaged in the study. They purchased their cannabis from a licensed vendor, and the THC levels reported on the labels were recorded. The researchers collected pre- and post-smoking samples of breath, swabs, saliva, and blood, with a target of impairment between 4 and 6 on a 10-point scale. In addition, police officers who were blinded to which volunteers had consumed cannabis conducted standard field sobriety tests to assess impairment.

After giving five deep breaths into the collection device, the amounts of THC that could be detected in the breath of the volunteers ranged widely, from trace amounts to levels that would indicate impairment. THC levels in the blood also varied significantly, with some below and some above the per se level indicating impairment, even though the volunteers reported that they were high.

Chronic users had THC levels before smoking that were above those of casual users after smoking. “This is the challenge facing law enforcement and any kind of compliance testing,” said Clowers. “We’re developing a presumptive test that can say whether or not something is present. But we can’t say whether or not somebody is high.”

Finally, Clowers presented data on whether the standard field sobriety test (SFST) was effective at detecting whether someone had a level of THC that would indicate impairment. More than half the chronic users who consumed cannabis passed the test, while some casual users who were below the per se limit failed it (Figure 2-4). This is “not a failure of the law enforcement officers,” said Clowers. “The tool wasn’t designed to do that. This is why we really need other tools not only to assess presence but also whether or not somebody is impaired.” For example, Clowers suggested that future efforts should be aimed at integrating a cognitive test in the field pre- and post-consumption, since cannabis appears to interfere with particular cognitive functions.

Whether cannabis is present in someone’s body and whether he or she is impaired are two different questions, Clowers concluded. Answering them will require more research support, more data, more rigorous analysis,

new tools, engagement with partners in other disciplines such as psychology, and more ways of overcoming the regulatory barriers associated with handling cannabis.

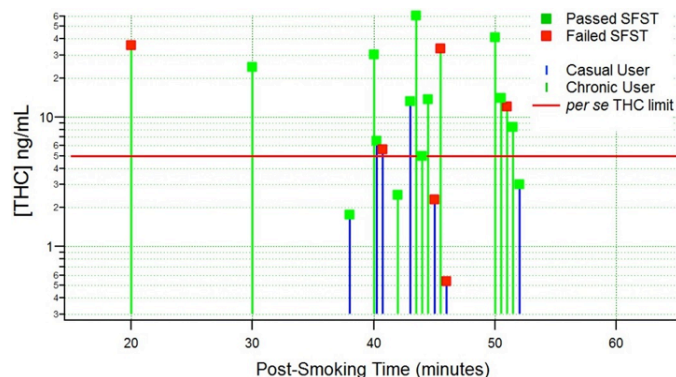


FIGURE 2-4 Some chronic cannabis users (green lines) passed the standard field sobriety test (SFST) despite having THC levels above the per se limit, while some casual users (blue lines) failed it (red squares) despite having THC levels below the limit.

3. The Regulation of Cannabis

Regulation of cannabis takes place at the international, national, state, and local levels. In his overview of cannabis research and regulation at the symposium, Nordquist focused mostly on national and state regulation and on the conflicts between them.

The Controlled Substances Act of 1970 prohibits most possession, distribution, and cultivation of “marijuana” and provides for criminal and civil penalties for violations. The act is how the United States has implemented the international Single Convention on Narcotic Drugs, which was passed in 1961, was amended in 1970, and covered 186 state parties as of 2018. Under the convention, the participating countries agreed to restrict the production, possession, and distribution of marijuana except for medical and scientific purposes.

Marijuana is classified as a Schedule I drug, along with heroin, LSD, and ecstasy (Figure 3-1). The most restrictive category under the Controlled Substances Act, Schedule I applies to drugs with no currently accepted medical use and a high potential for abuse. Marijuana “extracts” like CBD are also classified as Schedule I drugs. Repeated efforts to have the agency re-schedule marijuana to a lower classification have been unsuccessful, Nordquist noted.

and source limitations. Research involving cannabis possession, distribution, or cultivation may be done if it is conducted under a Schedule I registration from the Drug Enforcement Agency, uses cannabis obtained from the National Institute on Drug Abuse, and complies with all applicable federal and state rules. Of course, not all research involves actual contact with cannabis or cannabis extracts, and such research is acceptable.

The National Center for Natural Products Research at the University of Mississippi is the sole contractor for the federal government to grow marijuana to be used in research. However, several presenters at the symposium pointed to the problems associated with having just a single source of cannabis for research. (Stella, for example, noted that he often receives vials of cannabinoids that are probably oxidized and “very hard products to do research with.”) The Obama Administration initiated a process for the National Institute on Drug Abuse to license other cultivators, and more than two dozen facilities submitted proposals to be licensed as DEA marijuana manufacturers. However, the process has been stalled in the current administration. Nordquist noted that Washington State University considered applying for such a license but that the financial demands of producing and maintaining effective security controls on cannabis materials were too great.

The Food and Drug Administration, which like the National Institutes of Health is part of the Department of Health and Human Services, does scientific assessments that are used for scheduling marijuana, regulates research on potential therapeutic uses, and does enforcement of cannabis products for such issues as illegal claims in labeling. In addition, both the Food and Drug Administration and the National Institutes of Health need to review research if it involves human subjects.

In Washington State, the Liquor and Cannabis Board (LCB) oversees marijuana and marijuana research licenses, while the Washington State Department of Agriculture oversees the industrial hemp program (see the section “Industrial Hemp” later in this chapter). However, the Drug Enforcement Agency has stated that cannabis is still illegal under federal law, with some exceptions. The many conflicts between federal law and the provisions of Initiative 502 have yet to be worked out.

Nordquist briefly described the process through which researchers can apply for a Schedule I registration from the Drug Enforcement Agency. They must provide

C R I T E R I A	Abuse Potential		Low relative to CII	Low relative to CIII	Low relative to CIV
	High	High			
	No Medical Use	Medical Use			
S C H E D U L E S	Lack of accepted safety under medical supervision		Psychological or Physiological Dependence		
		Severe Psych or Physical	High Psych or Moderate to low Physical	Ltd Psych or Physical relative to CIII	Ltd Psych or Physical relative to CIV
	SCHEDULE I	SCHEDULE II	SCHEDULE III	SCHEDULE IV	SCHEDULE V
	Heroin Hallucinogens Marijuana Others	Opioids Barbiturates Cocaine Amphetamine Methylphenidate Methamphetamine PCP	Opioids (Codeine combinations, Buprenorphine) Barbiturates (combinations and products) Ketamine GHB Marinol Anabolic Steroids	Benzodiazepines and other depressants (Zaleplon, Zolpidem, Eszopiclone) Fenfluramine Modafinil Butorphanol Tramadol	Opioids in limited quantities and in combinations (Codeine, Dihydrocodeine, Difenoxin) Pregabalin Lacosamide

FIGURE 3-1 The federal government has classified marijuana as a Schedule I drug with a high potential for abuse and no medical uses.

The Drug Enforcement Agency within the Department of Justice is charged with enforcing the Controlled Substances Act. It also oversees registration of principal investigators and issues site licenses to conduct research on marijuana. The Controlled Substances Act does allow research on Schedule I drugs but with significant controls, including registration, background checks, inspections,

their research protocol, qualifications, security measures, and information on criminal controlled substances convictions. Just in the area of security measures, for example, they must provide information on square footage and storage location, construction materials of the vault, what security devices are installed, control contact switches, motion detectors, cameras, the type of lock on the door, the construction of the storage unit, and contact information for the security company or campus police. Relatively few investigators have applied for State of Washington research licenses, via the LCB, in Washington State, and “that doesn’t surprise me,” said Nordquist. Not many institutions have the facilities, personnel, equipment, and resources to do such research.

Nordquist concluded by highlighting just a few of the gray areas of regulation. One is a lack of clarity regarding the legal status of certain materials such as extracts or derivatives of the mature stalks of the cannabis plant. (“Mature stalks” are exempt from the definition of marijuana, but the Drug Enforcement Agency still lists all “marijuana extracts” as Schedule I.) Another example involves the extracts or derivatives (like CBD) that might be obtained from sources (such as yeast) other than a cannabis plant, or non-psychoactive extracts or derivatives (such as DNA) from a cannabis plant.

Accepting funds from the cannabis industry or conducting work for the industry or specific companies are other gray areas, Nordquist pointed out. The Department of Justice has stated that “Persons who are in the business of cultivating, selling or distributing marijuana, and those who knowingly facilitate such activities, are in violation of the Controlled Substances Act, regardless of state law.” Conducting cannabis research could be seen under certain circumstances as money laundering or conspiracy, Nordquist said, which is enough to keep many researchers away from cannabis research.

Cannabis research can be done, despite the many limitations and restrictions on such research, Nordquist concluded. But researchers and administrators must be aware of the legal landscape and comply with both state and federal laws.

APPLYING FOR A DEA SCHEDULE I HUMAN RESEARCH CERTIFICATE

Matt Layton, clinical education director for mind, brain, and behavior in the Elson S. Floyd College of Medicine and medical director for the Program of Excellence in

Addictions Research, College of Nursing, Washington State University, elaborated on some of the difficulties he and his colleagues have encountered in applying for a Schedule I certificate to conduct research on a new drug for humans. Their proposal was for a randomized, prospective, double-blind, placebo-controlled trial for chronic non-cancer neuropathic pain. They submitted an application to the Food and Drug Administration (FDA) the November before the workshop, and almost a year later it was still in process.

He noted first that the Institutional Review Board at Washington State University may not look favorably on requiring study participants to smoke cannabis; therefore, the protocol proposes to use cannabis extract in capsules with coconut oil as the placebo. An additional complication is that the research participants need to have used cannabis before, as human subjects reviewers also look unfavorably on exposing naïve individuals to a Schedule 1 substance. However, study participants will need to test negative for THC in their urine before they are randomized to the intervention or control arms of the study. They then have to agree to take the cannabis in the form in which it is administered, even if they would prefer to smoke it.

The primary endpoint for the study is changes in pain, but the secondary endpoint is reduction in the use of opioids. FDA required that the participants have a cutoff of how many morphine equivalents per day they are taking. In Washington State, taking more than 120 mg morphine equivalents per day requires getting a second opinion from a pain specialist. However, the FDA is requiring that Layton’s study participants be excluded if they are taking more than 40 mg morphine equivalents per day.

FDA also required that the researchers provide specific information about bad psychiatric effects experienced by the participants. These can be severe, Layton acknowledged. “Psychiatry residents talk about all the up sides of marijuana,” he said. “Psychiatry attendings talk about the down sides.” Patients can suffer from depression, anxiety, delusions, and hallucinations from their cannabis use.

One major concern of regulators is that using cannabis will trigger the use of other substances. But a 2015 study found that, although 40 percent of subjects reported combining cannabis with alcohol, the users of prescription pain medicine did not exhibit any difference with nonusers in either lifetime or past-three-months use of other drugs, including cocaine, street opioids, and amphetamines.²⁷

²⁷ Perron, B. E., K. Bohnert, A. K. Perone, M. O. Bonn-Miller, and M. Ilgen. 2015. Use of prescription pain medications among medical cannabis patients: comparisons of pain levels, functioning, and

Users also rated the efficacy of cannabis higher than prescription pain medicines for pain management and expressed a strong desire to reduce their use of those medicines.

Layton and his colleagues are proposing to administer cannabis in coconut oil, which serves to mask the scent of the compound so that research participants do not know whether they are getting the active substance or a placebo. However, FDA has required that the researchers demonstrate that the capsules of coconut oil with THC will remain chemically stable and will not break down over time. Doing so has required working with a specific consultant with a private laboratory and a Schedule 1 manufacturer's registration in Mississippi to perform such testing. It also has made the final cost of the capsules highly uncertain.

In addition to the requirements from FDA and the IRB, Layton and his colleagues will have to get approval from the Drug Enforcement Agency, which entails meeting the large variety of requirements that Nordquist specified. Finally, for approval, the researchers have had to demonstrate that the test will be safe in humans, despite the fact that 30 states have medical marijuana laws.

These requirements have consequences, Layton said. One of the top medical advice sites on the web, where many people could be expected to get their information about cannabis use, cites a single Canadian study from 2010 in its discussion of pain relief.

It is a frustrating process, he admitted. "That's why we're recruiting you to help us make this argument and to bring reason to the whole conversation," he said. "We all know we need more science, so let's get the science."

INDUSTRIAL HEMP

The regulation of industrial hemp provides an interesting counterpoint to the regulation of cannabis. The Agricultural Appropriations Act of 2014, also known as the Farm Bill, authorized the production of industrial hemp. The act, which was scheduled to expire shortly after the workshop, specifies that an institution of higher education or a state department of agriculture may grow or cultivate industrial hemp if the hemp is grown for purposes of research conducted under an agricultural pilot program or other agricultural or academic research and if the cultivation of industrial hemp is allowed under the laws of the state. It defines industrial cannabis as "the plant *Cannabis* patterns of alcohol and other drug use. *Journal of Studies on Alcohol and Drugs* 76(3):406-413.

sativa L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis." However, a license from the Drug Enforcement Administration may still be needed to obtain the industrial hemp seed or cultivars for such use.

Hemp is the same genus and species as cannabis, but marijuana and industrial hemp are genetically distinct, explained Laura Lavine, associate director for the Office of Research in Washington State University's College of Agriculture, Human, and Natural Resource Sciences. Because of the biochemical pathways that produce cannabinoids, hemp is generally high in CBD and low in THC, while marijuana is low in CBD and high in THC. However, the provision that hemp must have less than 0.3 percent THC requires that it be tested frequently to ensure that its THC levels are not too high.

Hemp has thousands of uses, Lavine observed. It is used in textiles, paper, building materials, industrial products, body care products, and food. In food, for example, its uses include hemp seed hearts, hemp seed oil, hemp protein powder, and food supplements. The estimated U.S. retail market for industrial hemp products in 2016 was \$688 million (Figure 3-2), though this does not necessarily represent a large market, Lavine observed. Wheat production is a \$700 million market in Washington alone, representing the third largest wheat market in the nation. Washington is number one in the nation for apple production, earning \$2.389 billion in revenue in 2016.

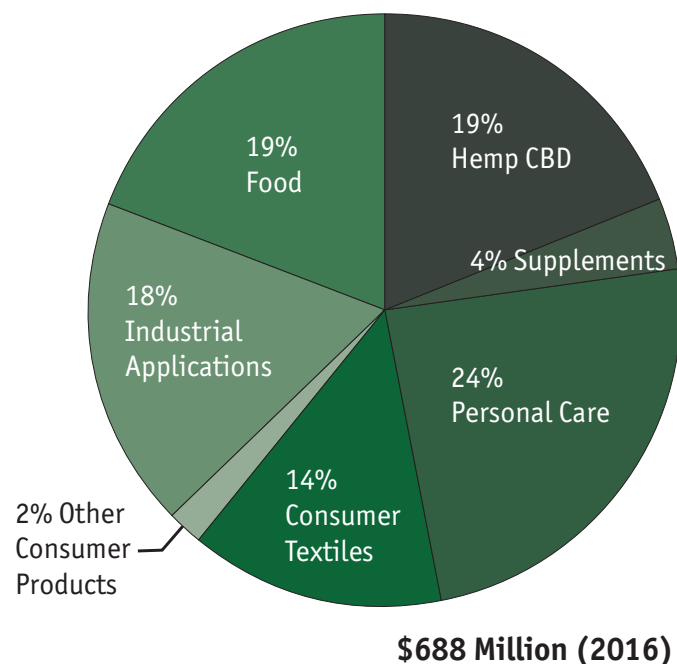


FIGURE 3-2 The market for industrial hemp in the United States is distributed among a variety of uses. Source: Hemp Industries Association.

Imports into the United States of hemp products were valued at \$67.3 million in 2017, up ten times from the value of hemp imports 12 years earlier. About two-third of these imports were of hemp seeds, with the remainder mostly hemp oil, seed cake, solids, and textiles. Most of these imports come from Canada, with China, European countries, India, the Dominican Republic, and Chile providing the remainder. Global production is primarily in Canada, Europe, China, South Korea, and Russia. Europe is the largest hemp-producing market, with 80,000 acres in production. Canada had 140,000 acres in production in 2017, but the amount of acreage planted to hemp has fluctuated there. Again, these areas under production should be compared to crops such as wheat, said Lavine, which had 50.2 million acres planted in the United States in 2017, including 2.14 million acres in Washington State.

By suggesting that industrial hemp could be a major market for U.S. farmers, the 2014 Farm Bill helped generate excitement about its cultivation. For example, the southeastern states have seen declines in tobacco cultivation, which could be replaced by hemp, Lavine said. In addition, Congress has blocked the U.S. Drug Enforcement Administration and federal law enforcement agencies from interfering with state agencies, hemp growers, and agricultural research through omnibus appropriations. Congress has also blocked the U.S. Department of Agriculture from prohibiting the transportation, processing, sale, or use of industrial hemp that is grown or cultivated in accordance with the 2014 Farm Bill. However, European countries have been considering changes in the low-THC standard, which could have the effect of blocking exports of hemp from the United States.

The U.S. Department of Agriculture and various states, including Arkansas, Kentucky, Maine, North Dakota, Oregon, and Vermont, have done feasibility studies of hemp production. The estimated gross value of hemp production per acre is \$21,000 from seeds and \$12,500 from stalks, with much higher estimates for hemp used for CBD extracts. In contrast, sweet cherries are worth about \$15,500 per acre in Washington States, and wheat is worth about \$485 per acre.

In 2017, 28 states had laws in place related to industrial hemp, and 13 states had active pilot programs for industrial hemp, including Washington State. Washington had five licensed industrial hemp research pilot program researchers in 2016-17, with Washington State University holding two of those. However, the pilot program was not funded in its second year, which has caused the number of researchers to drop.

In Washington, Bill 6206 allowed for an industri-

al hemp pilot program to be developed in the state. But in general the laws in Washington State are prohibitive toward the cultivation of industrial hemp, Lavine said. For example, Bill 6206 lays out several requirements to start an industrial hemp pilot program in the state related to licensing, THC testing, grower qualifications, locations of hemp fields, and other information deemed necessary. It is illegal in Washington to grow industrial hemp in the state for food or human consumption of any kind, including pharmacological use. In addition, industrial hemp is still subject to U.S. drug laws, growing industrial hemp is restricted, and all cannabis varieties are considered Schedule I substances and are subject to oversight by the Drug Enforcement Administration, Lavine observed. This oversight means that restrictions apply to the importation of viable seeds, commercial sales, and interstate transfer.

“There is a huge interest in being able to do this legally,” said Lavine. “But in the state of Washington, we’re not going to be able to grow industrial hemp unless the laws are less restrictive.” In Oregon, in contrast, the laws are far less restrictive. Oregon projects that as many as 200,000 acres could be in hemp production in 2019, which is close to the worldwide total today.

Lavine also pointed out that research on industrial hemp is desperately needed. For example, spider mites “love marijuana,” and since marijuana is related to hops, mites and other pests could jump back and forth between the two crops. At present, however, plant scientists such as Lavine cannot give recommendations to growers, “because it would be against the law and considered a conspiracy for us to give any advice.” Instead, she has to refer callers to other sources. “They’re on their own.”

IMPLEMENTING EVIDENCE-BASED PREVENTION AFTER LEGALIZATION

A final example of regulation described at the symposium involves the implementation of evidence-based prevention programs under Initiative 502. In Washington, funding of substance abuse prevention and treatment services is based on state data, research evidence from the field, and stakeholder input. This may be less unusual than it was a decade ago, but in many states the decisions about what gets funded is still not based predominantly on evidence, observed Laura Hill, professor and chair of the Department of Human Development at Washington State University. Washington’s collaborative evidence-based approach to allocating funding prevention has been a model for other state agencies across the United States.

A particularly important partner in the collaboration among state agencies, researchers, practitioners, and other stakeholders is the Washington State Institute for Public Policy (WSIPP), a nonpartisan organization funded by the legislature that conducts applied policy research for the state. One of its roles is to examine evidence on specific topics, such as substance abuse prevention, mental health treatment, or criminal justice programs, to produce inventories of programs and services that are both effective and cost beneficial.

WSIPP has a three-step approach to making that determination. First, it does an extensive search of the literature to identify programs that have rigorous research supporting positive outcomes. Second, it determines whether such programs are cost beneficial. Third, it determines the probability that benefits would exceed costs if those programs were delivered in Washington State.

Programs in WSIPP's top tier are called evidence-based programs. Those programs have had multiple site evaluations using randomized controlled trials, statistical designs, or systematic reviews. They are effective across heterogeneous populations or for an intended population; for example, a program that describes itself as targeting African American youth has to be shown to be effective with that group. The term heterogeneous is operationalized as achieving at least 32 percent minority participation in studies, which is consistent with Washington's demographics.

Programs in a second tier are called research-based programs. These have had at least one randomized controlled trial showing efficacy when delivered to a heterogeneous or targeted population.

Programs in a third category are called promising programs. These have limited research, but other reasons exist to think that they might become research based or evidence based or to contend that they have a special reason for being used, such as being targeted to a population that no other program targets.

In creating the Dedicated Marijuana Fund (DMA), Initiative 502 allowed the Division of Behavioral Health and Recovery (DBHR) to use up to 15 percent of DMA funds for marijuana prevention if at least 85 percent of the allocation was directed to evidence-based programs and to practices that produce objectively measurable results and are cost beneficial. "That's a tall order," said Hill. DBHR had already funded programs listed on the substance abuse prevention inventories from WSIPP as well as inventories from federal agencies and universities. While some of those programs targeted specific substances,

most aimed to prevent initiation and abuse of substances generally because different types of substance abuse tend to co-occur. There were very few programs that existed for marijuana prevention specifically.

Initiative 502 required DBHR to assess current programs and services in June 2013 and to identify those that were evidence based, cost beneficial, and had evidence for prevention of marijuana use. In a 2013 review of programs known to be effective in preventing marijuana use, DBHR came up with a list of 13 programs that they passed to WSIPP researchers, who examined those programs and ten others that they identified. Of the 23 programs, only two met the specified requirements of being evidence based and cost beneficial.

This posed a significant problem, said Hill, because numerous substance abuse prevention programs that had been delivered for years in Washington State and were well integrated into communities and schools would no longer qualify as evidence based and cost beneficial. "Communities and schools have invested funds for years in training staff, purchasing materials, publicity, and other costs of program delivery," noted Hill. "Those costs and the long-term infrastructure developed to support the implementations of those programs would be lost if we followed those provisions." In addition, community recognition and buy-in to programs were at risk.

In response to these complications, researchers were among those advocating for a change in the requirement. In 2015, Bill 2136 changed Initiative 502's original language so that at least 85 percent of funds must be directed to evidence-based or research-based programs that produce objectively measurable results and by September 1, 2020, are cost beneficial. This expanded the number of programs that could be delivered from 2 to 14 and extended the timeline for compliance.

In 2015-16, DBHR formed an evidence-based policy work group that included researchers from Washington State University and the University of Washington. The work group suggested expanding the criteria used to select programs to include not just marijuana outcomes but also the upstream risk and protective factors that are known to affect those outcomes. Washington State identified 55 high-quality programs using the new criteria, the University of Washington narrowed that list to the 35 most rigorous for DBHR review, and DBHR selected 13 evidence-based or research-based programs for funding. DBHR now confers regularly with this work group and with WSIPP and updates its list of accepted programs annually.

WSIPP's cost-benefit analyses have continual-

ly evolved to incorporate new evidence and improved methods. As a result, the algorithms used to calculate both effectiveness and cost-benefit ratios change, causing programs to go on and off lists as the models are updated. This problem will become worse in 2020, Hill said, when the cost-benefit requirement kicks in.

Hill suggested eliminating the cost-benefit requirement until more is known about what programs work in communities, how much they cost, and what their benefits are in the context of legalization in Washington. In addition, a new research agenda is needed to test programs in the context of legalization, she said. The effects of programs may be different when use is sanctioned by the state. Moreover, existing inventories based on data from controlled research settings do not necessarily apply to how those programs work in communities, since running a research program is very different from running a program in a community. Finally, she suggested modifying the current requirements for inventories by moving to reviews that occur every three or four years rather than annually.

The recent movement of DBHR from the Department of Social and Health Services to the Health Care Authority provides an opportunity to deliver evidence-based programs through primary care as a universal intervention, since people generally trust their pediatricians. The connection to primary care could help DBHR have broader reach for delivery of basic information about prevention and serve as a mechanism for referral to more targeted interventions, delivered to families or in schools and communities, where needed.

4. Themes of the Symposium

In the final session of the workshop, two prominent drug and alcohol abuse researchers identified several of the major themes and take-home messages that emerged from the symposium. Until retiring shortly before the workshop, Dennis Donovan was director of the Alcohol and Drug Abuse Institute and continues as professor emeritus at the University of Washington. Rita Fuchs is a professor and director of the Alcohol and Drug Abuse Research Program at Washington State University.

Donovan began by pointing to **the spectrum of potential effects of cannabis** on humans, ranging from harms to benefits. Cannabis use can trigger psychosis, and it harms many people who have psychiatric disorders and use marijuana chronically. At the same time, marijuana is now being studied as a potential treatment for posttraumatic stress disorder and other conditions. A major task for research is to figure out when and for whom marijuana is harmful and when and for whom it is beneficial, said Donovan, which in turn will raise a host of more detailed questions. For example, what are the effects of different compounds in cannabis, how does it interact with protective and risk factors, what are the effects of different ways to administer it, under what conditions is it harmful and beneficial, how do individual reactions to marijuana vary, and what are the effects of high THC levels? This wide-ranging research agenda is “a big challenge for us as scientists,” he said.

The **use of marijuana among adolescents**, in whom the brain is still undergoing major developmental processes, is another key topic for research, he said. The fact that cannabis use among adolescents in Washington State does not seem to have increased since the passage of Initiative 502 is intriguing. That has not been the case in other states that have legalized cannabis, which raises the question of what Washington State is doing right.

Scientists also need to understand more about **the effects of the messages delivered to cannabis users**, Donovan said. This research will need to be both quantitative and qualitative, as with the studies of pregnant and postpartum women described at the symposium. Scientists need to learn more about why people use cannabis, how it affects them, and the benefits and harms they experience. A valuable project would be to compare such information with the information in electronic medical records to see how attitudes and outcomes compare. “We need to achieve a sense of clarity and consensus around the messaging that we provide.”

In some cases, **innovative research approaches** will be needed to make progress, Donovan observed. Having people smoke marijuana and then arranging to do research on them, as with the studies of THC detection and impairment being conducted at Washington State University, are one interesting approach. Another might be arranging for a setting where people can be studied while they are using cannabis. Today, getting approval for such an experiment would be very difficult, but changes in regulations might make innovative research feasible.

The **difficult regulatory environment for cannabis research** has had a variety of effects, said Fuchs. It has affected not only the rate of progress but the types of research that can be done and the direction in which research progresses. The result has been a segmented research portfolio in which some areas of research have advanced while others have stagnated. For example, epidemiology has contributed to the development of services for cannabis use disorder. However, research using human subjects has been difficult. The only way to do such research is to jump through hoops, Fuchs observed, such as having research participants smoke marijuana at home and then driving them to a research facility, which has the potential to confound research results.

The same mixed effects are evident in **preclinical research**, including the animals research that Fuchs does. For example, the difficulty of overcoming regulatory obstacles has contributed to a delay in the development of technologies and animal models, she said. With animals, the drug has to be administered in ways that are not used in humans, which affects how the drug is absorbed and its effects. These difficulties are gradually being overcome. As an example, she mentioned a new piece of equipment in which mice can be trained to inhale vaporized cannabis extract, which has many advantages for research. The result has been “a translationally relevant model that we now can use to study a number of questions, ranging from adolescent cannabis use to changes in cognitive function and brain structure.”

Donovan and Fuchs both raised the issue of **changing the classification of marijuana as a Schedule I drug**. Marijuana does not fit in the same category as heroin or hallucinogens, they said. Picking up on this point, Fuchs noted that some states have created a new schedule for cannabis since it does not fit into the other schedules. Rescheduling cannabis or creating a new schedule for it will not be easy, Donovan observed, but doing so would over-

come many of the regulatory barriers described during the symposium. “Persistence is a virtue,” he remarked.

Both Donovan and Fuchs supported the other presenters at the symposium who said that **the Dedicated Marijuana Fund should be used for the purposes specified in Initiative 502**. “We need to do what the voters of the state voted for,” said Donovan. “The original intent of I-502 was to provide funds that could be used for public health, prevention, treatment, and research. All of those areas have been grossly underfunded. If I were to ask legislators for one thing, it would be to put back in place the original intent for the use of those funds at the levels at which they had originally been allocated. We’ve been very productive with limited funds. Just think of where we could be if in fact we were given the funding that had originally been allocated to us.”

Fuchs suggested that researchers **help educate legislators** about the importance of cannabis research. Even research that seems quite abstract can have a connection to public policy concerns, she pointed out. For example, Washington State University has projects that look at the interactions of THC with the vagus nerve, which helps control the heart, lungs, and digestive system. “Why would we care about that? It so happens that the fastest growing population of cannabis users are 50 plus,” and the function of the vagus nerve has many health implications for older people. “Legislators will not pick up on that unless we tell them that these kinds of things are important.”

She also called attention to **the mismatch between legislative appropriations and research schedules**. Most legislators do not understand or have experience with the amount of time it takes to do research and may make unreasonable requests for results and updates. (This is particularly the case for single-year appropriations, Donovan added.) The same goes for investments into the physical infrastructure needed to conduct research. If these and other obstacles to research could be overcome, she said, Washington State could become “attractive to leaders in the field, which will stimulate people not only to move to the state of Washington but also to collaborate with us and help us move forward.”

Finally, Donovan lauded **the long tradition of cooperation and mutual support between the two major universities in Washington State**. Building on this collaborative tradition, as Fuchs, too, urged, could make Washington State a leader in cannabis research.

Appendix A

SYMPOSIUM AGENDA

Symposium Introduction

12:30 – 12:40 Ron Thom, President

A Brief History of Cannabis

12:40 - 1:00 John Roll, Symposium Chair, Professor and Vice Dean for Research, Elson S. Floyd College of Medicine, Washington State University, **"A Brief History of Cannabis and Humanity"**

Federal and State Regulatory Environments for Cannabis Research

1:00 - 1:45 Dan Nordquist, Associate Vice President for Research Support and Operations, Washington State University, **"Current Regulatory and Administrative Landscape of Marijuana Research"**

1:45 – 2:05 Laura Lavine, Assistant Director, Office of Research, College of Agriculture, Human, and Natural Resource Sciences, Washington State University, **"Opportunities and Challenges for Hemp as an Agricultural Commodity"**

2:05 – 2:20 **BREAK**

Cannabis Research

Prevention

2:20 – 2:40 Kevin Haggerty, Endowed Associate Professor in Prevention, University of Washington, **"Six Lessons Learned from Marijuana Legalization in Washington State: One Researcher's Perspective"**

2:40 – 3:00 Laura Hill, Professor and Chair, Department of Human Development, Washington State University, **"Policy Complications of Implementing Evidence-Based Prevention After Legalization"**

3:00 – 3:20 Celestina Barbosa-Leiker, Associate Dean of Research, College of Nursing, Washington State University, **"Daily Cannabis Use During Pregnancy and Parenthood"**

Health/Social Impacts Research

3:20 – 3:40 Nephi Stella, Professor of Pharmacology and Psychiatry and Behavioral Sciences, University of Washington, **"Optimizing the Medical Properties of Cannabis: from Concept to Proof-of-concept"**

3:40 – 4:00 Matt Layton, Clinical Education Director, Mind, Brain and Behavior, Elson S. Floyd College of Medicine, Washington State University, **"The Cannabis Conundrum: Applying for a DEA Schedule 1 Human Research Certificate"**

4:00 – 4:20 Michael McDonell, Associate Professor, Elson S. Floyd College of Medicine, Washington State University, **"The Impact of Cannabis on Mental Health"**

4:20– 4:35 Nicholas Lovrich, Regents Professor Emeritus, Politics, Philosophy and Public Affairs, Washington State University, **"Roadway and Workplace Cannabis Impairment: Progress to Date & Future Developments"**

4:35-4:50 **BREAK**

Research Informing Medical and Behavioral Health Practice and Policy

4:50 – 5:05 Dennis Donovan, Director, Alcohol and Drug Abuse Institute, University of Washington, **Discussant**

5:05 – 5:20 Rita Fuchs Lokensgard, Director, Alcohol and Drug Abuse Research Program, Washington State University, **Discussant**

Next Steps for WSAS

5:20 - 5:30 **Discussion facilitated by John Roll**

5:30 **ADJOURN**

Appendix B

SYMPOSIUM SPEAKERS

John Roll, Symposium Chair, *"A Brief History of Cannabis and Humanity"*



Dr. Roll is currently a Professor and the Vice Dean for Research for the Elson S. Floyd College of Medicine and the Associate Vice President for Health Sciences Research for Washington State University. He is the Founding Director of the WSU Program of Excellence in Addictions Research (PEAR) and is the Co-Director of the WSU Translational Addiction Research Center (TARC). Dr. Roll holds faculty appointments in the WSU Departments of Medicine, Psychology, Neuroscience, Nursing, Prevention Science, Nutrition Exercise and Physiology and Health Policy Administration. He was appointed by Washington state Governor Gregoire as an Executive Commissioner on the Eastern State Hospital Advisory Board and as a Vice Chair of the Governor's Council on Substance Abuse. Roll is a Fellow of the following organizations: American Psychological Association, Association for Behavior Analysis International, Association for Psychological Science, and the American Association for the Advancement of Science. He has published more than 160 scholarly articles.

Dan Nordquist, *"Current Regulatory and Administrative Landscape of Marijuana Research"*



Dr. Nordquist is the Associate VP/Deputy VP for Research Support and Operations for Washington State University and reports to the Vice President for Research. Dan oversees the pre-award office, Conflict of Interest (COI) management, the OR Information Technology group, and supports the implementation of the University's research strategic plan. In addition, as directed by the VPR, in the role of Deputy VPR, Dan provides support and operational services to all Office of Research Units.

He started at WSU in 1990 working at the local, college, and central levels. All of his roles encompass research administration and operations. Dan is active nationally and internationally in various leadership roles and participates in national working groups associated with research administration.

Dan has significant experience as a member or in support of many WSU committees including IRB, IBC, IACUC, RSC, Intellectual Property, Research and Arts, Audit Steering Committee, Investment Review and Plan Oversight Advisory Committee, and the Committee on Cannabis Research and Outreach.

Laura Lavine, *"Opportunities and Challenges for Hemp as an Agricultural Commodity"*



Dr. Lavine is the Associate Director of the Washington State University, College of Agricultural, Human and Natural Resource Sciences, Agricultural Research Center/Office of Research. She has also recently been named the Chair of the WSU Department of Entomology. Dr. Lavine is a Full Professor whose research on the evolution of adaptation has been published in such journals as *Science*, *Proceedings of the National Academy of Sciences*, and *Nature* to name just a few. Dr. Lavine is committed to teaching and has been honored with the WSU CAHNRS Wade Excellence in Teaching award. Dr. Lavine has shown an ongoing and dedicated commitment to inclusion and diversity in higher education and was awarded the Samuel H. Smith Leadership Award in 2016 by the WSU Association for Faculty Women. Dr. Lavine received her Ph.D. in Entomology at the University of Kentucky in 1999

and was a USDA NIFA Postdoctoral Fellow at the University of Wisconsin-Madison with National Academy of Science member Michael R. Strand before coming to WSU in 2001.

Kevin Haggerty, *“Six Lessons Learned from Marijuana Legalization in Washington State: One Researcher’s Perspective”*



Dr. Haggerty is the Director of the Social Development Research Group and Endowed Professor of Prevention at the UW School of Social Work. He is a principal investigator on a variety of projects, including Utah Communities That Care Training program, Staying Connected with Your Teen, Families Facing the Future (formerly Focus on Families) and a National Institute on Drug Abuse-funded study on Family Connections. He is an investigator of the Community Youth Development Study, which tests the effectiveness of the Communities That Care (CTC) program. Dr. Haggerty specializes in prevention programs at the community, school and family level. For more than 30 years, he has focused on developing innovative ways to organize the scientific knowledge base for prevention so

that parents, communities and schools can better identify, assess and prioritize customized approaches that meet their needs. An expert on substance abuse and delinquency prevention, Dr. Haggerty speaks, conducts trainings, and writes extensively on this field.

Laura Hill, *“Policy Complications of Implementing Evidence-Based Prevention After Legalization”*



Dr. Hill is a professor and chair of the Department of Human Development and faculty in the interdisciplinary Prevention Science PhD program at Washington State University. Dr. Hill studies implementation and dissemination of research-based programs as they move into community settings. A primary aim of her translational research program is to improve the efficiency, effectiveness, and evaluation of preventive interventions in uncontrolled, real-world settings.

Dr. Hill is a member of the Board of Directors of the Society for Prevention Research and chair of its Training Committee. She co-chairs the Prevention Research Subcommittee of the Washington State Division of Behavioral Health and Recovery and is a member of the state's Department of Health committee addressing education and prevention related to the legalization of cannabis. Previously, she chaired the Committee on Cannabis Research and

Outreach. Her research on program implementation, adaptation, and economic evaluation has been funded by the National Institutes of Health, other federal and state agencies, and private foundation grants.

Celestina Barbosa-Leiker, *“Daily Cannabis Use During Pregnancy and Parenthood”*



Dr. Barbosa-Leiker is the Associate Dean for Research and an Associate Professor in the College of Nursing at Washington State University (WSU). She is also the Director for the Program of Excellence in Addictions Research and a member of the Committee on Cannabis Research and Outreach at WSU. Dr. Barbosa-Leiker’s primary research investigates gender differences in opioid use. Her research has demonstrated sex differences in the measurement of opioid withdrawal, relapse while in treatment, and predictors of relapse. Her additional line of research focuses on the transition from pregnancy to parenthood in women with substance use disorders. She is currently leading an interdisciplinary research team to assess mothers, infants, and healthcare providers in order to better care for women with opioid use disorders, as well as for women using cannabis during pregnancy. The results of these studies will help better educate healthcare providers and

pregnant women, inform maternal and infant health policy, and improve standards of care. Dr. Barbosa-Leiker has methodological expertise in psychometrics and longitudinal latent variable modeling.

Nephi Stella, “Optimizing the Medical Properties of Cannabis: from Concept to Proof-of-concept”

For over 20 years, Dr. Stella has studied the molecular mechanism and therapeutic value of cannabinoid-based molecules (phytocannabinoids and synthetic cannabinoids) and endogenously-produced cannabinoids (endocannabinoids) for the treatment of various diseases of the brain, including epilepsy and brain cancer. His initial work led to the discovery of both the prominent endocannabinoid, 2-arachidonylglycerol (2-AG), in the brain, and its key degrading enzyme, ABHD6, that controls the activity dependent production of 2-AG in the brain. The body of work started at the University of Washington led to the optimization of several medicinal properties of phytocannabinoids (such as cannabidiol), synthetic cannabinoids (such as ST compounds) and targeting ABHD6 for the treatment and possible cure of devastating diseases such as Dravet Syndrome, glioblastoma multiform and brain metastasis. In 2011, he founded Stella Therapeutics,

Inc; a University of Washington start-up company dedicated to developing cannabinoid-based drugs the safely treatment of cancer. In 2017, Dr. Stella became director of the University of Washington Center for Cannabis Research.

Matt Layton, “The Cannabis Conundrum: Applying for a DEA Schedule 1 Human Research Certificate”

Dr. Layton is the Medical Director for the WSU Program of Excellence in Addictions Research and Physician-Record for the WSU Sleep and Performance Research Center in addition to his appointments as a Clinical Professor in the UW Department of Psychiatry and Behavioral Sciences and in the Department of Medical Education and Clinical Sciences in the Elson S. Floyd College of Medicine at WSU. Dr. Layton is certified by the American Board of Psychiatry and Neurology, and he is a Distinguished Fellow of the American Psychiatric Association and a Fellow in the American College of Psychiatrists. He is also a member of the American Medical Association, Washington State Psychiatric Association, Washington State Medical Association, and the Spokane County Medical Society. He has published numerous scientific articles in the fields of psychopharmacology and

neuroimaging, presented research findings in national and international forums, and received awards from the National Alliance for Research in Schizophrenia and Depression, National Institute of Mental Health, American Federation for Clinical Research, American Psychiatric Association, Washington Community Mental Health Council, and he is listed as one of “America’s Top Psychiatrists”.

Michael McDonell, “The Impact of Cannabis on Mental Health”

Dr. McDonell is an Associate Professor in the WSU Elson S. Floyd College of Medicine and an Affiliate Associate Professor in the UW Department of Psychiatry and Behavioral Sciences. He is the Chair of the Committee for Cannabis Research and Outreach at WSU and a member of the Program of Excellence in Addictions Research (PEAR). Dr. McDonell has an extensive background in developing and testing the effectiveness of treatments for co-occurring substance use disorders and severe mental illness. He is also active in public health research and behavioral interventions in American Indian and Alaska Native communities, as well as research focused on first episode psychosis and child abuse prevention. Dr. McDonell has published more than 50 articles, chapters, and books in the areas of substance use and psychiatric disorders. His clinical background includes over 14 years of delivering evidence-based interventions for addiction and mental health problems in community clinics. Significant awards include the American Fisheries Society

Fish Health Section S. F. Snieszko Distinguished Service Award and the US Department of the Interior Distinguished Service Award. He is an author of more than 200 scientific publications.

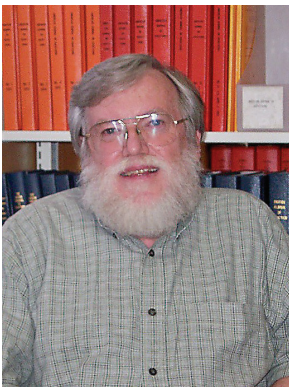
Nicholas Lovrich, "Roadway and Workplace Cannabis Impairment: Progress to Date & Future Developments"



Dr. Lovrich enjoys the rank of Regents Professor Emeritus in the School of Politics, Philosophy and Public Affairs and the honor of holding a Claudius O. and Mary W. Johnson Distinguished Professorship in Political Science at WSU. He is currently on partial appointment as a research affiliate in the Department of Criminal Justice and Criminology, serving as a Co-PI on a 3-year grant from the National Institute of Justice to document the impact of marijuana legalization on police and crime in Washington. He is the author/co-author/co-editor of 13 books, 175 peer-reviewed articles, and over 20 edited book chapters. He chaired 30 PhD dissertation committees at WSU.

Since 2010 he has been working with Herb Hill and Brian Clowers in the WSU Department of Chemistry to develop a means of rapid field detection of THC by means of the application of ion mobility spectrometry (IMS) in law enforcement and workplace safety settings. The WSU team has been coordinating efforts with Michael Milburn (UMass, Boston) for the past two years to collect data simultaneously on THC exposure and cognitive/motor skills driving impairment.

Dennis Donovan, *Discussant*



Dr. Donovan received his Ph.D. in Clinical Psychology from the University of Washington, where he is Director of the Alcohol and Drug Abuse Institute and Professor in the Department of Psychiatry and Behavioral Sciences. He has over 35 years of experience as a direct service provider, treatment program administrator, and clinical researcher in the alcohol and drug dependence field. He served as the Associate Director and Acting Director of the Department of Veterans Affairs Center of Excellence in Substance Abuse Treatment and Education. His research has been funded by the National Institutes of Health, and has resulted in 220 peer-reviewed publications, 35 book chapters, and 5 books. He has served as an assistant editor and member of the editorial boards for a number of professional journals. He is the Principal Investigator of the Pacific Northwest Node of the NIDA National Drug Abuse Treatment Clinical Trials Network (CTN). He has served as President of the Society of Psychologists in Addictive Behaviors and is a Fellow

in Divisions 28 (Psychopharmacology and Substance Abuse) and 50 (Society of Addiction Psychology) of the American Psychological Association.

Rita Fuchs Lokensgard, *Discussant*



Dr. Fuchs Lokensgard is a Professor in the Department of Integrative Physiology and Neuroscience at Washington State University (WSU) and Director of the WSU Alcohol and Drug Abuse Research Program (ADARP). Dr. Fuchs Lokensgard's laboratory utilizes rodent models to explore neural circuitry and cellular mechanisms by which drug-associated environmental stimuli elicit craving and motivation for drugs of abuse in substance abusers. Her research is funded by the National Institute on Drug Abuse and Washington State Initiative 171. As director of ADARP, Dr. Fuchs Lokensgard administers research grant competitions and other programs designed to foster substance abuse research at WSU. ADARP is funded through Washington State Initiatives 171 and 502.

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