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Measuring Youth Cannabis Use in Washington State

The 2018 Legislature directed WSIPP to “examine current data collection methods measuring use of cannabis by youth and report to the legislature on potential ways to improve data collection and comparisons.”¹

In this paper, we describe the current state of data collection on youth cannabis use in Washington and explore ways it might be improved. [Section I](#) provides background information on the need for collecting information about youth use of marijuana. [Section II](#) details the main source of public health data for youth in Washington, the Healthy Youth Survey (HYS). [Section III](#) describes how survey data collection might be improved, and [Section IV](#) summarizes our findings.

To inform our examination, we consulted the research literature on the relationships between marijuana² use and subsequent life outcomes, we reviewed recently developed surveys designed to measure cannabis use, and we spoke with individuals familiar with the HYS or other methods of assessing youth marijuana use.

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Summary

In 2018, WSIPP was assigned to examine current methods for measuring youth marijuana use and to identify potential improvements. We focused on the primary source of data on youth marijuana use in Washington, the Healthy Youth Survey (HYS).

In considering improvements to the HYS we reviewed current research on harmful consequences of marijuana use, with the aim of identifying specific aspects of use that are most strongly related to harm. Inconsistency in prior measurement prevented clear identification of the most harmful aspects, but the evidence suggests that features of intensive cannabis use are important to measure.

We also examined five recently developed surveys of cannabis use to identify common elements of newer approaches, and we spoke to a number of experts for insight into the status of the HYS, the practical realities of revising it, and methods for measuring cannabis use, more broadly.

Marijuana use is a complex phenomenon to measure, particularly amidst the dynamic context of legalization. We identified a series of practical revisions to the marijuana questions in the HYS that would both allow for clearer description of the changing varieties of marijuana use among youth and would provide an economical reflection of more intensive—and more harmful—versions of use. These changes could be more readily accomplished if the HYS moves to electronic administration, a prospect that is currently being considered by HYS planners. These improvements can be expected to increase the utility of HYS data for prevention planning.

¹ [Engrossed Substitute Senate Bill 6032, Section 606\(18\)\(b\)](#).

² The terms “marijuana” and “cannabis” are used interchangeably in this report.

I. Background

Adult marijuana legalization has raised concerns about unintended consequences for youth: that youth may view marijuana use as more acceptable, have greater access to the drug, and use it more.³ These concerns highlight the importance of research to monitor changes in youth cannabis use and its effects on their development and well-being. Data on the status of youth marijuana use are essential to responding to these concerns.

There are many methods for measuring youth cannabis use. Among the most common are self-report surveys,⁴ clinical instruments to screen and assess symptoms of substance use disorder,⁵ biochemical tests (e.g., hair samples),⁶ and content analysis of internet or social media traffic.⁷ Surveys are the favored method for gathering information about substance use at the population level because they can feasibly be administered to large numbers

of people, enabling representative population estimates.

The primary source of data on youth marijuana use in Washington is a school-based survey called the Healthy Youth Survey (HYS). HYS data are collected in the fall of even-numbered years and are currently comparable from 2002 through 2018, the most recent year of data available.⁸ HYS data are used to monitor the well-being of youth in Washington, to plan prevention and intervention services throughout Washington communities, to evaluate the effects of programs and policies, and to conduct academic research.

Although marijuana use remains illegal for youth in Washington, changes in the legal status of marijuana for adults and the developing commercial cannabis market have a variety of potential effects on youth. Beyond basic indicators of whether or not youth use marijuana, the drug is available in an increasing variety of forms and each form can be consumed in different ways. Furthermore, the amount of marijuana youth consume, the intensity of their use over shorter periods, or duration of use over longer periods of time may all be important aspects of youth use to understand.

³ Adult marijuana legalization was effected in Washington in 2012 with the enactment of [Initiative Measure No. 502](#).

⁴ Compton, W.M, Thomas, Y.F., Conway, K.P., & Colliver, J.D. (2005). Developments in the epidemiology of drug use and drug use disorders. *American Journal of Psychiatry* 162, 1494–1502.

⁵ Annaheim, B. (2013). Who is smoking pot for fun and who is not? An overview of instruments to screen for cannabis-related problems in general population surveys. *Addiction Research & Theory*, 21(5), 410-428 and Lopez-Pelayo, H., Batalla, A., Balcells, M.M., Colom, J., & Gual, A. (2015). Assessment of cannabis use disorders: A systematic review of screening and diagnostic instruments. *Psychological Medicine*, 45, 1121-1131.

⁶ Taylor, M., Lees, R., Henderson, G., Lingford-Hughes, A., Macleod, J., Sullivan, J., & Hickman, M. (2017). Comparison of cannabinoids in hair with self-reported cannabis consumption in heavy, light and non-cannabis users. *Drug and Alcohol Review*, 36, 220-226.

⁷ Chary, M., Genes, N., Giraud-Carrier, C., Hanson, C., Nelson, L.S., & Manini, A.F. (2017). Epidemiology from tweets: Estimating misuse of prescription opioids in the USA from social media. *Journal of Medical Toxicology*, 13, 278-286.

⁸ Due to substantial changes in data collection methods in 2002, HYS data collected prior to 2002 are not considered comparable to later years.

As we discuss in the next section, most population surveys, as currently configured, provide limited information on these specific aspects of marijuana use. More comprehensive measurement of cannabis use can support improvements in basic knowledge of how youth use marijuana, how that is changing within the dynamic context of legalization, and how specific aspects of marijuana use relate to harmful outcomes. Such improvements in the marijuana research base could support more effective use of HYS data for prevention and wellness promotion.

One by-product of marijuana legalization in Washington is that a portion of revenue from legal marijuana sales is dedicated to support HYS data collection (\$500K annually since FY2016), stabilizing what was previously a piecemeal arrangement of funding and in-kind contributions by partner agencies.⁹ Funding for the HYS is an essential aspect of Washington's capacity to monitor youth well-being. Only half of the eight states to first legalize had dedicated funding for marijuana data collection.¹⁰

We begin by describing the HYS in terms of three key aspects of survey data collection methods: survey construction, mode of administration, and sampling. We then consider potential improvements to the HYS on each of those aspects.

⁹ Prior to marijuana funding the HYS was funded primarily by tobacco settlement money, which has dwindled in recent years. A portion of the allocation of marijuana revenue to the HYS is expended on the Washington Young Adult Health Survey, described later.

¹⁰ Council of State and Territorial Epidemiologists. (2018). [CSTE Marijuana Surveillance: Environmental Scan Report 2018](#).

II. The Washington Healthy Youth Survey (HYS)

As with any survey, there are many aspects of HYS data collection methods to consider. Survey construction concerns what the survey attempts to measure and the specific wording of questions (commonly referred to as “items”) and response formats (e.g., strongly agree/strongly disagree). The mode of administration (e.g., pencil-and-paper, computer-assisted, interviewer-administered) has important implications for respondents’ perception of security in sharing sensitive information. Finally, sampling methods determine who responds to the survey and how well the sample reflects the intended population. Below we describe each of these three aspects of HYS methods.

Survey Construction

The HYS covers a variety of topics related to youth well-being, but we are focused here on the items addressing marijuana. A core set of items concerning marijuana use has been measured since 2002. These include whether or not a student has ever used cannabis, age of first use, and frequency of use in the past 30 days.

Another set of items consistently measured since 2002 address attitudes toward marijuana. The use of population survey data for prevention purposes requires identifying factors that predict later substance use, which can be the focus of prevention activities before substance use has occurred. These so-called “risk and protective factors” are measured in the HYS by items concerning attitudes about how wrong or harmful it is to use cannabis, or how easy it is to access, for example.¹¹

A number of marijuana items were added in 2014, the first wave of HYS data collection following legalization in Washington (I-502 was enacted December 2012). The additions included items assessing where youth obtain their marijuana, methods used to consume marijuana, use on school property, and driving under the influence of marijuana. Subsequent years saw the addition of several other items, including an item addressing simultaneous use of marijuana with alcohol. The expansion of HYS items addressing marijuana in recent years is shown in [Exhibit 1](#).¹²

¹¹ Hawkins, J.D., Catalano, R.F., & Miller, J.Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin*, 112(1), 64-105.

¹² The HYS is administered in three separate versions (Forms A, B, & C); most of the cannabis items appear in Form A. See Healthy Youth Survey Planning Committee. (2018). [2018 Healthy Youth Survey Form A](#).

In this report, we focus on the items addressing marijuana use: lifetime use, age of initiation, frequency of use over the past 30 days, method of consumption, and duration of high. The methods for measuring whether or not youth use, how often they use, what types of marijuana they use, and how much they use, are rapidly evolving. Together, these aspects of marijuana use have the potential to identify more intensive versions of use, and this is the area of HYS item content where we found the greatest potential for improvement.

For practical reasons, we do not further address other marijuana-related items from the HYS in this report, making no statement about their importance in doing so. This includes the numerous items concerning attitudes and perceptions about marijuana (risk and protective factors). We also set aside items concerning use on school property, driving under the influence of marijuana, and simultaneous use of marijuana with alcohol. The importance of each of these topics can be supported by the scientific literature, and we only set them aside for the sake of focusing on the aspects of marijuana use where we found the greatest potential for improvement.

Exhibit 1

Addition of Marijuana-Related Items to the Healthy Youth Survey in Recent Years (Items That Are the Focus of This Report are Outlined)

2002-2018

Lifetime marijuana use
Age of first marijuana use
Past month frequency of use

Ease of access to marijuana
Likelihood of getting caught by police for using marijuana
Number of best friends who use marijuana
Parents view marijuana use as wrong
People in neighborhood view marijuana use as wrong
I view marijuana use as wrong
Perception that trying marijuana is harmful
Perception that regular marijuana use is harmful

Added in 2014

Source of marijuana
Someone in household uses marijuana
Parents have discussed why I should not use marijuana
Friends view marijuana use as wrong
Method of consumption (e.g., smoke, vape, edibles, liquids)
Current marijuana use on school property
Drove within 3 hours of using marijuana
Rode in a car driven by someone who used marijuana in past 3 hours

Added in 2016

Duration of high when using marijuana
Current e-cig/vape marijuana/THC

Added in 2018

Simultaneous use of marijuana and alcohol

Mode of Administration

The HYS is completed by students in pencil-and-paper format during class time. Students are assured of the anonymity of their responses, no direct identifiers are collected, and completed surveys are submitted by students directly into an envelope for submission to HYS data collectors.

Students make their responses on "opscan" forms which can be readily digitized. The electronic data are screened for data quality using a variety of methods. The survey includes an item asking respondents how truthful they were, and it also asks students how often they use a drug name that does not exist. Surveys with either indication of dishonesty are screened out. Patterns of responses such as largely incomplete surveys, impossible responses, or clear logical inconsistencies in responses between items are also used to screen out surveys with dubious data quality.

Although it is a familiar mode of survey administration, there are numerous limitations of paper surveys. In comparison to the competing alternative—electronic administration—paper surveys have much less flexibility in terms of survey construction. Currently, three different versions of the HYS are administered—one for 6th graders and two different versions for older youth, each with a different set of items. This allows for a larger set of items to be administered to the sample overall without making any one respondent complete all the items. However, logistical demands of fielding multiple versions of a survey are much greater with a paper survey.

Another limitation of paper surveys is that a respondent must read all items in the survey, whereas an electronic survey can present items adaptively based on prior responses. Later in this report we consider other advantages of electronic administration of the survey as a potential improvement in measuring youth marijuana use.

Sampling

In the HYS, probability sampling is used to select schools by grade level. Specifically, all public schools with a 6th grade are identified, and a random sample of these schools is selected. This process is repeated for schools with an 8th grade and schools with both 10th and 12th grades. Within sampled schools, all students in target grades are invited to participate.

In addition to the schools and students in the HYS random sample, all other non-sampled schools with grades in the target range are invited to participate in the so-called “census” portion of HYS data collection.

The use of random sampling is a strength of HYS methods because it ensures that selection of students is not biased. Each school has an equal probability of being selected, as do all students in selected schools (in the target grade level), thus any differences between selected schools and the population of all eligible schools are determined by chance. Random selection increases the likelihood that the HYS sample will mirror the characteristics of the overall population of schools. However, random samples may still not precisely match the characteristics of the target population because schools that are selected may choose not to participate, and students within any participating school may opt out.

The census portion of HYS data collection may be less likely to accurately represent the overall population because school selection is determined entirely on a volunteer basis, and characteristics of schools that volunteer may be systematically different from all schools in the population. On the other hand, the census is substantially larger than the sample, so it offers greater representation of small subgroups, such as specific schools or demographic groups.

A bias analysis is conducted each year of the survey to assess the extent to which the HYS sample and the census represent the overall population of public schools in Washington.¹³ In the most recent bias analysis, both the sample and the census appeared very similar to the overall population in most regards.¹⁴

The major strength of HYS sampling is its extensive access to public schools in Washington. However, students in private schools, online schools, schools in correctional facilities, and home-schooled students, as well as youth who do not attend school of any kind, are generally not included in the HYS sample, which limits the perspective offered by the HYS.

¹³ [HYS Analytic Reports](#) provide more detail on methods and results of the HYS, and [HYS Bias Analysis reports](#) offer more detail on sample characteristics with respect to the target population.

¹⁴ Looking Glass Analytics. (2018). *Washington State Healthy Youth Survey: 2016 Bias Analysis*. Olympia: WA.

III. Potential Improvements

Having described the current methods of the HYS, next we contemplate potential improvements along the same three aspects of survey data collection methods: survey construction, mode of administration, and sampling.

Survey Construction

Although there have been numerous valuable changes to HYS marijuana item content in recent years, the pace of change in marijuana products, methods of consumption, terminology, and scientific understanding of the drug's effects all contribute to the necessity of continuously considering updates to the measurement approach. In this section, we explore potential improvements to survey items from two perspectives. First, we briefly review current evidence on the relationships between marijuana use and harmful consequences, with the aim of identifying aspects of use that are most strongly associated with negative outcomes. Then, we examine several recently developed measures of cannabis use that illustrate the many facets of marijuana use that can be measured, beyond what is currently measured by the HYS.

Core HYS measurement of youth marijuana use consists of items assessing whether youth have ever used, the age of first use, and frequency of use in the past 30-days. More recently, items were added assessing methods of consuming marijuana and how long youth are high on a typical use occasion.

In [Exhibit 2](#) we situate the aspects of marijuana use that the HYS measures within the broader context of aspects of marijuana use that can be measured. This framework is not necessarily exhaustive, and the terms we use to refer to each aspect of marijuana use are not firmly established outside of this report. The purpose of this framework is to familiarize the reader with various conceptual aspects of cannabis use, and to establish terminology to refer to conceptual aspects that will be used in discussing potential improvements to marijuana item content.

Aspects of Marijuana Use Associated with Harmful Consequences.

Among the many aspects of cannabis use that can be measured, we first sought to identify potential improvements to the HYS by focusing on aspects of use that are most likely to lead to harmful consequences. This strategy was based on the reasoning that prevention activities may produce the greatest long term returns if they are focused on the most harmful aspects of marijuana use.

Exhibit 2
Conceptual Aspects of Marijuana Use

Concept	Description	Addressed by HYS
Lifetime use	Yes/no assessment of whether someone has ever used marijuana.	✓
	Other yes/no indicators of types of use ever in someone's lifetime are also possible, such as lifetime regular use or lifetime use of specific product types.	X
Age of initiation	Age of first use.	✓
	Age of initiation of other aspects of use are also possible, such as initiation of regular use or use of certain product types.	X
Frequency of use	Number of days used in the past 30 days.	✓
	Frequency of use can be measured over different time periods (e.g., number of times per day, in the past week, or in the past year).	X
Most recent use	Can be used to determine how long someone has been abstinent or to measure acute (i.e., recent) use.	X
Number of use occasions	The total number of times someone has used marijuana in their life.	X
Duration of use	The total amount of time someone has been a marijuana user.	X
Patterns of use	More detailed accounting of variation in use and intensity of use over the lifetime is also possible. For example, identifying the overall duration of time someone has been a frequent user, or differentiating a recently initiated occasional user from a former heavy user who is now abstinent.	X
Other	Time of day someone typically first uses marijuana.	X
Product type	Marijuana is produced in a variety of forms, and these forms are evolving as legal markets develop. Examples of product type are flower (i.e., bud), edibles, and concentrates.	X
Method of consumption	Marijuana can be consumed by various methods, including smoking, vaping, ingestion, and topically. Many product types can be consumed by more than one method.	Partially
Potency	Typically a measure of THC concentration but may also measure CBD content. Can be measured numerically (e.g., 20% THC concentration) or by more approximate approaches (e.g., high THC, low CBD).*	X
Amount of marijuana	Typically approached by the amount of a specific type of product one uses on a typical use occasion. Measurement approaches range from numerical estimates of quantity using images of known amounts, to more approximate approaches such as the HYS strategy of asking how long participants typically stay high.	Partially

Note:

* THC is delta-9-tetrahydrocannabinol, the main psychoactive compound in marijuana. CBD is cannabidiol, the other principal compound in marijuana, which is generally considered to be non-psychoactive.

To explore aspects of cannabis use associated with harmful consequences, we consulted a recent comprehensive review of scientific literature conducted by the National Academy of Sciences (NAS).¹⁵ The NAS review considered the most credible and recent peer-reviewed evidence on both benefits and harms of cannabis in a range of different outcome areas, including infant birthweight, cancer, mental health, injury, and mortality, to name a few. More than 288 systematic reviews and 6,500 primary research studies were reviewed and assessed for relevance and methodological quality using established criteria. A committee of experts categorized the strength of evidence for each outcome on a scale ranging from no or insufficient evidence, to limited, moderate, substantial, and conclusive levels of evidence.¹⁶

Because there are a large number of different outcomes in the NAS review, we focused on outcomes that are relevant to youth prevention and that had moderate or substantial levels of evidence. These outcome areas were driving safety; learning, memory, and attention; schizophrenia and psychosis; depression; suicidality; social anxiety disorder; and substance use disorder.¹⁷ We also included two outcome areas that were rated at the limited level of evidence—academic achievement and social functioning—because of their strong relevance to youth prevention.¹⁸

¹⁵ National Academies of Sciences, Engineering, and Medicine (NAS). (2017). *The health effects of cannabis and cannabinoids: The current state of evidence and recommendations for research*. Washington, DC: The National Academies Press.

¹⁶ NAS (2017), Appendix B.

¹⁷ Due to our focus on prevention, we omitted outcomes concerning progression of disorders (e.g., worsening of depression symptoms).

¹⁸ The NAS review is not strictly limited to studies demonstrating causal effects—it preferred well-executed

Within each outcome area we were primarily interested in conceptual aspects of marijuana use that were associated with the outcome and how those aspects were measured. In many cases, the NAS review discussed differences in how cannabis use was measured and how relationships to outcomes varied accordingly. Of particular interest were dose-response relationships, in which the relationship between marijuana use and outcomes was stronger for more intensive versions of use. The NAS review noted dose-response relationships for psychosis, depression, suicidality, and progression to substance use disorder. The review also found that the relationship between marijuana use and social anxiety disorder was specific to daily/near-daily users.

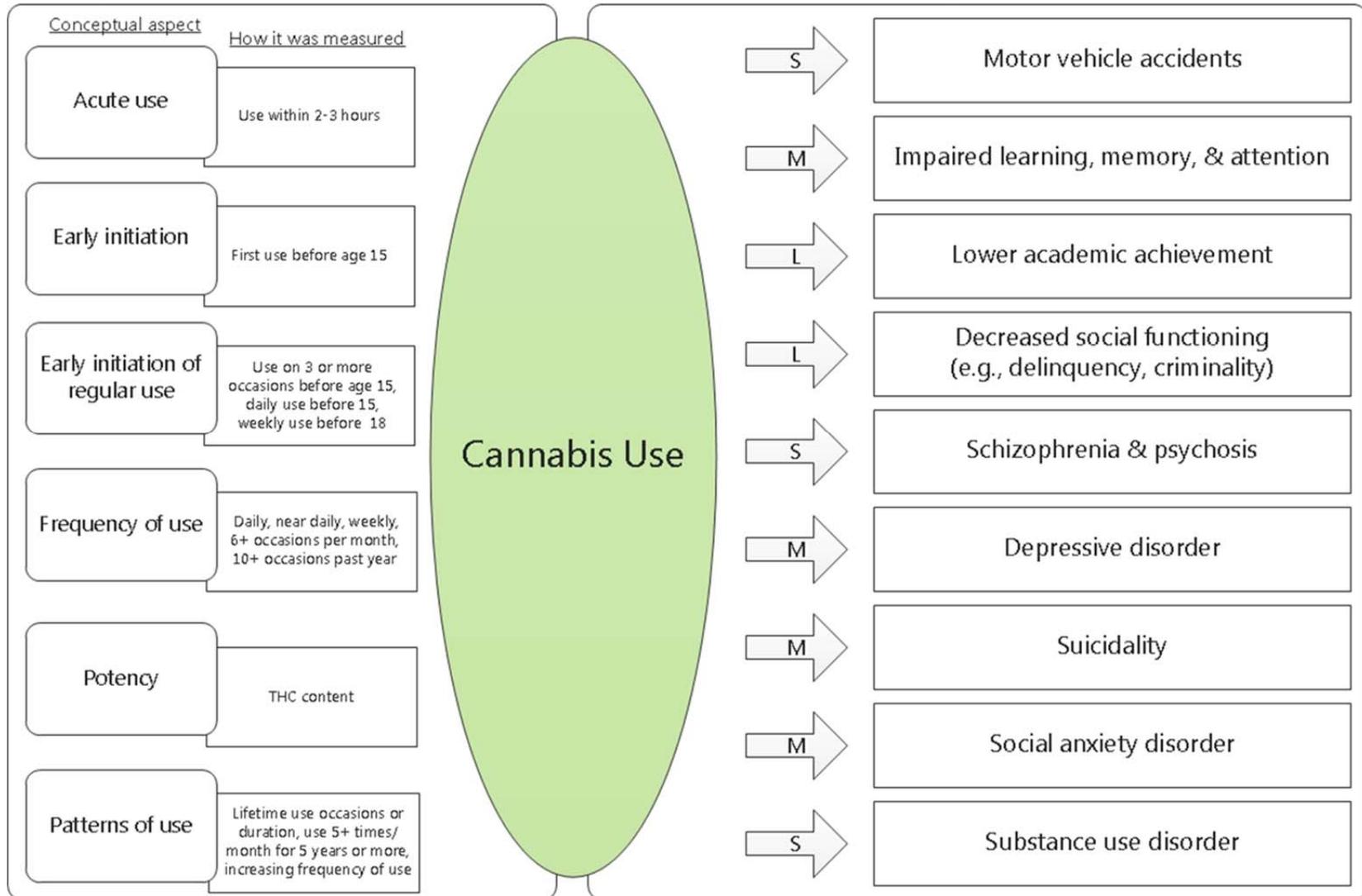
Across outcome areas, cannabis use was measured in many different ways. To simplify matters, we grouped the different ways cannabis use was measured by the more general conceptual aspect of use they measured. In [Exhibit 3](#) we summarize the various ways cannabis use was measured in these studies, and we indicate the NAS findings on the strength of the evidence associating cannabis use with each outcome.¹⁹

randomized controlled trials and quasi-experimental designs, but it also included studies with relatively weaker designs when those were the best available. The outcomes described in this report range from limited to substantial levels of evidence, and we take a conservative approach interpreting all relationships between marijuana and outcomes as correlational. Also, the review was not limited to youth populations—it included longitudinal studies following participants from youth to adulthood, along with studies of adult populations.

¹⁹ In the [Appendix](#), we provide a more detailed description of the NAS review's findings on associations between cannabis use and outcomes.

Exhibit 3

Selected Outcomes Associated with Marijuana Use from NAS Review and Aspects of Cannabis Use Associated with Outcomes
 WSIPP Exploration of Cannabis Measures in NAS Review NAS Outcome Areas & Evidence Ratings (L=Limited, M=Moderate, S=Substantial)



Note:

Strength of evidence ratings are based on the quality and amount of evidence supporting the relationship between cannabis use, in general, and the outcome area, and not for specific measures of cannabis use. Strength of evidence does not indicate the strength of the relationship between cannabis use and the outcome—for example, there could be substantial evidence that cannabis use is associated with a relatively small change in a given outcome.

Implications for the HYS. Among the many and various aspects of marijuana use that have been associated with harmful consequences, the evidence does not yet support the identification of specific aspects that clearly stand out as most harmful. In various places throughout the NAS review, inconsistency in measurement of cannabis use is blamed for difficulty in drawing conclusions. Because use has been measured so inconsistently across studies, it would be premature to rely on existing evidence to identify the most harmful aspects of use at this time.

However, the numerous dose-response relationships strongly suggest that there may be important differences between types of cannabis use, just as there are differences between cannabis users and non-users. Given that THC (delta-9-tetrahydrocannabinol) is the main psychoactive compound in marijuana, measurement focused on the amounts of THC people consume is most likely to link to progression to disorder and addiction and other harmful consequences that follow from THC intoxication.²⁰ It remains unclear whether different harmful consequences result from large cumulative amounts of THC consumed less intensely over longer periods, versus more intensive versions of consumption of large amounts of THC in short periods of time.

²⁰ An exclusive focus on THC may be an oversimplification in light of developing research suggesting that cannabidiol (CBD) may counteract the adverse effects of THC. See Niesink, R.J.M., & van Laar, M.W. (2013). Does cannabidiol protect against adverse psychological effects of THC? *Frontiers in Psychiatry, 4* and Mammen, G., Rueda, S., Roerecke, M., Bonato, S., Lev-Ran, S., & Rehm, J. (2018). Association of cannabis with long-term clinical symptoms in anxiety and mood disorders: A systematic review of prospective studies. *Journal of Clinical Psychiatry, 79*(4).

Taking the familiar case of alcohol as a model, ethanol is the compound of singular importance, and its consumption in liquid form is measurable by volume in a known set of product types (i.e., wine, beer, and liquor). Beverage-specific standard units can then be defined and amounts consumed readily measured, leading to research that has identified quantity thresholds for high-risk drinking that inform public health intervention.²¹

The situation is considerably more challenging in the case of marijuana because it is available in many more types of products, each product type has varying degrees of potency and can be consumed in different ways, and marijuana is pharmacologically more complex than alcohol (e.g., how it is metabolized and how cannabinoids such as CBD & THC interact). The difficulty is enhanced by the dynamic state of legal cannabis markets and the products they offer as well as the developing state of research on the effects of cannabis.

We turned to recently developed surveys of cannabis use to see how they approach these complexities. Because there is so much to learn about varieties of cannabis use and how they relate to outcomes, recently developed surveys tend to cast a wide net in measuring aspects of cannabis use.

Recent Developments in Survey Measurement of Cannabis Use.

We examined five recently developed surveys to see how they approach the challenge of assessing cannabis use (Exhibit 4). Each survey was developed for a somewhat different purpose, so some differences between them can be expected, but there are many elements that are potentially applicable to the HYS.

²¹ White, A.M., Tapert, S., & Shukla, S.D. (2018). Binge drinking: Predictors, patterns, and consequences. *Alcohol Research: Current Reviews*, 39(1), 1-2.

Exhibit 4

Recently Developed Surveys of Marijuana Use and Approaches to Specific Measurement Issues

	YAHS	CDNCS	DFAQ-CU	CCS	ICPS
Title	Washington Young Adult Health Survey ^a	Canadian Cannabis Survey ^b	Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory ^c	Cannabis Consumption Survey ^d	International Cannabis Policy Survey ^e
Description	Online survey of young adults age 18-25 designed to examine effects of legalization in WA	Nationwide online survey of population 16 and older designed to monitor effects of legalization in Canada	Online survey designed for psychometrically sound measurement of dimensions of cannabis use to support basic research on the effects of cannabis in humans	Online survey designed primarily to assess the total amount of cannabis consumed in WA and other states	Online survey of cannabis use designed to examine effects of legalization in Canada, including data collection in the US
Reference to the drug	“When we say ‘cannabis,’ we mean any form of the drug, including marijuana (weed, pot), hashish, or kief, and any method of use, including dried buds/flowers/leaves for smoking or in edibles, or hash oil.”	“When we use the term cannabis, this includes marijuana (e.g., weed, pot), hashish, hash oil, or any other products made from the cannabis plant but not synthetic cannabinoids... this includes cannabis in its dry form or when mixed or processed into another product such as an edible, a concentrate, including hashish, a liquid, or other product.”	“The term cannabis is being used to refer to marijuana, cannabis concentrates, and cannabis-infused edibles.”	“We will use the word ‘cannabis’ to refer to marijuana, hashish, hash oil, edibles, vapes, dabs, etc.”	“We will use the term ‘marijuana’ (also known as cannabis, pot, weed, hash, kush, or CBD) to refer to <u>all</u> of the different forms of the plant and its preparations, including: dried herb, edibles, oils, hash or kief, concentrates (wax, shatter, budder, etc.), marijuana drinks (tea, cola), etc., tinctures, lotions, or other marijuana products.”
Synthetic marijuana	Not addressed in definition of marijuana, but separate items assessing use of synthetic marijuana	Excluded from definition of marijuana	Not addressed at all	Not addressed at all	Not addressed in definition of marijuana, but separate items assessing use of synthetic marijuana

	YAHS	CDNCS	DFAQ-CU	CCS	ICPS
Medical marijuana	Not addressed in definition of marijuana; some items assess medical and non-medical use separately	Specified in definition of marijuana, and medical and non-medical cannabis assessed completely separately	Not addressed in definition of marijuana; item identifying respondents with a medical authorization; item assessing percentage of total cannabis use that is for medical purposes	Medical and non-medical use not distinguished	Not addressed in definition of marijuana, but there is an item distinguishing respondents with a medical authorization
CBD-only products	Not addressed in definition of marijuana	Not addressed in definition of marijuana	Not addressed in definition of marijuana	Not addressed in definition of marijuana	Included in definition of marijuana
Product type & method of consumption	Measured in combination using a single item from the HYS	Measured separately	Measured separately	Measured separately	Measured separately
Time period for frequency of use days	Past year & month	Past year	Current frequency (from once a year to daily) and number of days in past month and week	Past month & week	Past year, month, & week for cannabis in general, and past year for specific product types
Amount of cannabis per use occasion	Assessment of quantity with photographs for reference, for marijuana flower only	Product-specific assessment of quantity	Product-specific assessment of quantity with photographs for reference	Product-specific assessment of quantity with photographs for reference	Product-specific assessment of quantity with photographs for reference
Potency	Intensity of high on typical use occasion	Product-specific THC & CBD % or milligrams	Product-specific THC %	THC % of preferred product type	Product-specific THC/CBD ratio in high/low terms and THC & CBD % or milligrams

Notes:

^a Kilmer, J.R., Larimer, M.E., Rhew, I.C., & Dashtestani, K.S. (2018, March). *4 years later: Preliminary repeated cross-sectional and longitudinal findings from the Young Adult Health Survey*. Presentation made at the Washington State Epidemiological Outcomes Workgroup meeting, Lacey, WA.

^b Health Canada. (2018). *The Canadian Cannabis Survey 2018 Methodological Report*.

^c Cuttler C., & Spradin A. (2017). *Measuring cannabis consumption: Psychometric properties of the Daily Sessions, Frequency, Age of Onset and Quantity of Cannabis Use Inventory*. *PLoS ONE* 12(5).

^d Cuttler C., & Spradin A. (2017). *Measuring cannabis consumption: Psychometric properties of the Daily Sessions, Frequency, Age of Onset and Quantity of Cannabis Use Inventory*. *PLoS ONE* 12(5).

^d Kilmer, B., Davenport, S., Smart, R., Caulkins, J., & Midgette, G. (forthcoming). *After the grand opening: Assessing cannabis supply and demand in Washington State*. Santa Monica: RAND Corporation.

^e Hammond, D., Goodman, S., Leos-Toro, C., Wadsworth, E., Reid, J.L., Hall, W., . . . Elliot, R. (2018). *International Cannabis Policy Survey*.

Below we summarize common elements of the newer surveys that are potentially applicable improvements to the HYS.

Reference to the Drug. Measurement of drug use begins with a reference to the drug in question. Because marijuana goes by many names and comes in many forms, it is especially important to establish specifically what is being referred to, and what is not, in posing questions about its use.

Unlike the more recently developed measures, the HYS does not use introductory instructions to define marijuana. Instead, a number of items simply use the term “marijuana,” and items assessing marijuana use refer to “marijuana or hashish (weed, hash, pot).” All of the more recently developed surveys define the drug in question more specifically, using an introductory statement preceding the questions (see [Exhibit 4](#)).

The need for specific reference to the drug is particularly apparent for several marijuana variants: synthetic marijuana, medical marijuana, and CBD-only products. As detailed below, without explicit treatment of these varieties in the reference to the drug, a respondent could reasonably question whether their use should be included in answering questions about “marijuana.”

Synthetic Marijuana. Synthetic marijuana products (e.g., K2, Spice) contain synthetic chemical compounds that are designed to mimic how THC interacts with the nervous system. Synthetic marijuana products are psychoactive, but because they do not contain THC they are not banned by marijuana prohibitions that define marijuana

in terms of THC,²² and they are not detectable by conventional marijuana drug testing.²³ Thus, they are marketed as safe and legal alternatives to marijuana. However, a recent review of their pharmacological properties found that the use of synthetic marijuana results in “a constellation of adverse effects that are distinct from, and markedly more toxic than, those produced by marijuana.”²⁴ Therefore, it seems important to differentiate synthetic marijuana and explicitly omit it from the definition of marijuana.

Whether the HYS should include items concerning synthetic marijuana on its own is another matter. Synthetic marijuana can be expected to be less appealing where real marijuana is legal. However, marijuana use remains illegal for youth in Washington, and synthetic cannabinoids are only illegal in terms of manufacture, distribution, and sale, so there remains some legal incentive for youth to choose synthetic cannabinoids over marijuana.²⁵ Drug testing that does not account for synthetic marijuana may also provide an incentive.

²² Specific compounds in synthetic marijuana have recently been banned federally and in some states, but the chemical composition of synthetic marijuana can be modified to skirt those prohibitions.

²³ The synthetic cannabinoids in synthetic marijuana products can be tested for in workplace drug testing, but marijuana testing, because it is focused on THC, is not a valid test for synthetic marijuana.

²⁴ Ford, B.M., Tai, S., Fantegrossi, W.E., & Prather, P.L. (2017). Synthetic pot: Not your grandmother’s marijuana. *Trends in Pharmacological Sciences*, 38(3), 257–276.

²⁵ [RCW 69.50.455](#).

Medical Marijuana. Prior research has shown that a substantial portion of medical users also use for recreational purposes.²⁶ Major population surveys have not typically distinguished medical and recreational marijuana use, either in reference to the drug or by assessing these types of use separately, and it is unclear whether the potential harms of marijuana use apply equally to medical use.

As shown in [Exhibit 4](#), newer surveys are inconsistent in their approach to distinguishing medical marijuana use. The CDNCS makes the most extensive distinction, conducting a completely separate assessment of medical and non-medical use. Other surveys measure cannabis use generally, but then identify users who have a medical authorization or assess the percentage of overall use that is for medical purposes.

Differentiating instances of use that are for medical or recreational purposes is likely to be a subjective judgment for respondents, therefore difficult to measure well. However, a survey item distinguishing marijuana users who use for medical use only, recreational use only, or both, would provide a simple approach to beginning to explore differences in medical and non-medical use.

CBD-Only Products. Federal passage of the 2018 Farm Bill has stimulated a surge in the popularity of another cannabinoid, cannabidiol (CBD). In general, CBD is a Schedule I controlled substance, but the Farm Bill legalized specific types (i.e., CBD that is derived from hemp and that satisfies other specific

²⁶ Pacula, R.L., Powell, D., Heaton, P., & Sevigny, E.L., (2015). Assessing the effects of medical marijuana laws on marijuana use: The devil is in the details. *Journal of Policy Analysis and Management*, 34(1), 7-31.

conditions.)²⁷ This has led to the regular retail sale of various CBD products that contain no THC.²⁸ Because these CBD-only products are derived from cannabis, a respondent could reasonably include them in responding to questions about marijuana. However, because they do not contain THC, they are categorically different in terms of risks and consequences.

In summary, explicit definition of marijuana to exclude synthetic marijuana and CBD-only products and to include medical marijuana could improve clarity for respondents and improve the accuracy of the responses they provide. In addition, distinguishing users who use solely for medical purposes, non-medical purposes, or both, is another potential improvement.

Product Type and Method of Consumption.

Product type and method of consumption are two closely related but distinct concepts. Most product types are only consumed in one way; for example, edible products are ingested and topicals are applied to the skin. However, two of the most common product types,²⁹ flower and concentrates, can be consumed in various ways (e.g., smoking, vaping).

²⁷ Hudak, J. (2018). *The Farm Bill, hemp legalization and the status of CBD: An explainer.*

²⁸ In Washington, marijuana is defined in terms of THC content, and licensed marijuana retailers are limited to sales of marijuana and products for consuming marijuana, so they are not allowed to sell CBD-only products. CBD-only products are available for retail sale outside of the licensed marijuana system. Licensed marijuana retailers do sell products that contain relatively large amounts of CBD and low THC. Like CBD-only products, such high-CBD products may also be substantially different from other marijuana products, but differentiating high-CBD products could be practically difficult, as it requires a respondent to know more precisely how much THC and CBD are in the products they consume, so we focus on CBD-only products for practical reasons.

²⁹ Smart, R., Caulkins, J.P., Kilmer, B., Davenport, S., & Midgette, G. (2017). Variation in cannabis potency and prices in a newly legal market: Evidence from 30 million cannabis sales in Washington State. *Addiction*, 112(12).

Prior to 2014, the HYS asked only if youth had “smoked” marijuana, but the word “smoked” was replaced with “used” in the first movement towards accounting for variety in product type and method of consumption. Later, an item was added to assess how respondents usually consume marijuana, with the choices: “smoked it (in a joint, bong, pipe, blunt); ate it (in brownies, cakes, cookies, candy); drank it (tea, cola, alcohol); vaporized it; dabbed it; and used it some other way.”³⁰

Although it is primarily concerned with method of consumption, as currently constructed this item also attempts to address product type at the same time. All of the newer surveys assess product type and method of consumption separately (Exhibit 4), with the exception of the YAHS which copies the HYS approach. The use of separate items can be expected to improve clarity to respondents. It would also allow researchers to more completely describe the various types of marijuana that youth consume, methods of consumption, and product-by-method combinations, supporting investigation of how these change as the legal market develops and how they are associated with harms.

Specifying the response options for these two items could be challenging. Across the surveys we reviewed, there were differences in response options for both product type and method of consumption. Actual product types and methods of consumption appear to be evolving as legal markets develop, and terminology tends to be colloquial. Therefore it is particularly important that items assessing product type

and method of consumption be pilot tested with youth, and the input of industry participants may also be useful to finalize the construction of these items.

Frequency of Use. The HYS assesses frequency of use in the past 30 days, but most of the recently developed surveys assess frequency of use over the course of a year. As opposed to a 30-day reference period, a 12-month window can account for inconsistency in use over time, identifying use among users who have not used in the past month or who have used more intensively in other months, bridging the gap between 30-day use and lifetime use currently provided by the HYS. The 12-month window can also better reflect chronic use than the 30-day window. However, the 30-day window is compatible with national surveys, so the consideration here may be an additional item to preserve comparability to national surveys and other states.

Lifetime Patterns of Use. A person’s intensity of marijuana use may vary considerably over time. After initiating cannabis use they may or may not continue to use, they may use heavily for an extended period of time then quit, they may use heavily in intermittent episodes—the possibilities are endless. Between assessment of lifetime use, age of initiation, and 30-day frequency, the HYS lacks information on patterns of use. Most of the newer surveys include more detailed accounts of the variability in use over time for a given individual.

³⁰ This item appears in Form A of the HYS; Form B of the HYS includes an item concerning use of e-cigs/vape device for THC consumption.

The YAHS uses a single item assessing change in frequency of use over the past year (see [Exhibit 4](#)). As an example of a more extensive approach, the DFAQ-CU assesses current frequency of use, how long the respondent has used at that frequency, and their frequency prior to that current level. It also assesses age of initiation of regular use, frequency of use before age 16, and most recent use.

Extensive measures of lifetime patterns of use are probably not feasible given the space limitations of the HYS. An economical approach could be to assess age of initiation of regular use, past-year frequency of use, and most recent use. Because younger people tend to have shorter use careers, this approach could provide an efficient approach to describing lifetime patterns of use among youth.

Amount of Use per Use Occasion. Most of the recently developed surveys assess amount of use per use occasion, using pictures of quantities of marijuana and a product-specific approach (e.g., amounts of flower, concentrates, edibles). Most of the newer surveys also ask respondents to estimate the potency of their cannabis by product type. Combined with product type, method of consumption, frequency of use, and lifetime duration of use, identifying the amount of use per use occasion and potency would provide a complete assessment of the amount of THC users have consumed. However, product-specific assessment of quantity and potency is not feasible within the format of the HYS.

The current approach to approximate THC dosages per use occasion in the HYS is a question that asks respondents how many hours they are typically high on a use occasion. The YAHS asks a similar question with responses on a scale from not at all high to very high. This approach could provide a reasonable approximation of intensity of THC consumption per use occasion. However, it is notable that frequency of use is strongly correlated with the amount of cannabis consumed per use occasion—for example, users who consume on more days tend to consume more cannabis per day.³¹ This suggests that frequency of use is a good proxy for the amount of THC consumed per use occasion, particularly in combination with clear measurement of product type and method of consumption. For the purpose of monitoring youth marijuana use and planning and evaluating prevention services, it may not be necessary to take on the complexities of directly measuring amounts of THC consumed.

Summary of Potential Improvements to HYS Item Content.

The scientific literature on marijuana use includes a variety of evidence that marijuana use is associated with harmful consequences, including effects on cognition, academic achievement, mental health, and traffic safety. A number of dose-response relationships indicate that not only are marijuana users at greater risk of harmful outcomes, but the intensity of marijuana use exacerbates that risk.

³¹ Kilmer, B., Caulkins, J.P., Midgette, G., Dahlkemper, L., MacCoun, R.J., & Pacula, R.L. (2013). *Before the grand opening: Measuring Washington State's marijuana market in the last year before legalized commercial sales*. Santa Monica: RAND Corporation.

However, our understanding of “intensity” of use is in an early stage of development. For some outcomes, recent use appears most important, and for other outcomes greater frequencies of current use and long-term use have been associated with increased harm. Inconsistencies in how marijuana use has been measured, and the rapidly changing context of legalization, prevent drawing more specific conclusions about the aspects of use that are most harmful.

Recently developed surveys tend to measure many more aspects of marijuana use than are currently measured in the HYS. Although some of these surveys are designed to serve a somewhat different purpose than the HYS, the review of their similarities and differences suggests a variety of practical improvements to the HYS. We have considered these potential improvements in light of the serious practical constraints on revising the HYS.

Existing surveys like the HYS tend to resist changes to items for a variety of reasons. In the case of the HYS, new items cannot typically be added without eliminating existing items, and existing items have a loyal following from one group or another. Revisions to existing items threaten comparability of findings over time. Finally, many items in the HYS duplicate items from national surveys, and changing them diminishes comparability to other locations.

Against these reasons for preserving the current approach, we would weigh the need for adaptation to the dynamic circumstances currently surrounding marijuana—legalization, diversification of products, and developing research knowledge—which suggest that changes to HYS marijuana measurement will be in particularly high demand for the foreseeable future.

Combining these practical considerations with evidence from the literature on harmful consequences and recently developed approaches to survey measurement of marijuana use, we identified the set of potential improvements shown in [Exhibit 5](#).

Exhibit 5

Potential Improvements to HYS Item Content

- Clarify the definition of terms used to refer to the drug (e.g., “marijuana”); specifically, exclude synthetic marijuana and CBD-only products and include medical marijuana.
- Distinguish youth who use solely for medical purposes, non-medical purposes, or both.
- Measure product type and method of consumption separately.
- Measure frequency of use over the past year.
- Measure age of initiation of regular use.
- Measure most recent use.

Practical Considerations for Changes to HYS Item Content.

When assessing a topic that is also measured by a national survey, such as the National Survey on Drug Use and Health, the HYS tends to copy the item wording from the national survey, to enable comparison to national estimates, and in some cases, other states. Alignment with other surveys is not so straightforward now, as many surveys are changing to keep up with the evolving context of marijuana legalization. In considering changes to marijuana measurement in Washington and alignment with other locations, the Council on State and Territorial Epidemiologists is a venue for collaboration and alignment of state measurement approaches.³²

Survey changes that affect existing items are likely to reduce the comparability of data over time. To preserve comparability, such changes can be introduced partially, in a portion of surveys administered in a given year, to determine the effect of the change to the item on measured levels of marijuana use. This was the approach taken when HYS marijuana items were changed from “smoking” to “using” marijuana. The effect of the wording change on measured levels of use can then be estimated, and measurements before and after the change can be adjusted to account for the change.

Pilot testing (also known as cognitive testing) of new or revised survey items can help to ensure that an item addresses what it is intended to measure, in terms that survey respondents understand. Items that are thoroughly tested before introduction into the survey can be expected to perform better than untested items.³³

³² Council on State and Territorial Epidemiologists.

³³ Willis, G.B., & Artino Jr., A.R. (2013). What do our respondents think we're asking? Using cognitive interviewing to improve medical education surveys. *Journal of Graduate Medical Education*, 5(3), 353-356.

A commonly recognized limitation of survey data is inaccurate reporting by respondents, especially when assessing behaviors perceived to be wrong or illegal. In measuring marijuana use among youth, under-reporting is usually suspected, but there is evidence that both under-reporting and over-reporting occur. Inaccurate reporting is best identified by comparison of survey data to biochemical test results for the same respondents. One study in Washington found that survey data underestimated actual marijuana use by 25% due to inaccurate reporting, an estimate that accounted for under- and over-reporting by comparison to biochemical testing.³⁴

Those data were collected more than a decade ago, before any state had legalized marijuana. One of the biggest challenges in interpreting survey data on marijuana use before and after legalization is the inability to determine whether changes in reported use reflect changes in use or changes in willingness to report use. Although it is no small task to conduct biochemical testing for drug use in conjunction with survey data collection, doing so before and after legalization would help to identify how much the accuracy and honesty of survey responses about marijuana use change with legalization. Although it is too late to conduct such a study in Washington, a

³⁴ Kilmer et al. (2013); In the Kilmer study, survey estimates were adjusted upwards by 25% due to inaccurate reporting, but other sources of bias in survey data, such as from sample selection and survey completion, were also accounted for. Kilmer et al. used data from Harrison, L.D., Martin, S.S., Enev, T. & Harrington, D. (2007). *Comparing drug testing and self-report of drug use among youth and young adults in the general population*. (SMA)07-4249. For further information, an analysis of the Colorado marijuana market provides a review of under-reporting estimates for survey measurement of marijuana use. See Light, M.K., Orens, A., Lewandowski, B., & Pickton, T. (2014). *Market size and demand for marijuana in Colorado*.

study in another state would provide extremely valuable information for interpreting changes in marijuana use from surveys in general (not only the HYS), allowing a more precise focus on changes in actual marijuana use.

Next, we move on to consider potential improvements in how the HYS is administered and how the sample of respondents is obtained.

Mode of Administration

Currently, the HYS is administered on paper, which entails the distribution of thousands of surveys and response forms in schools across the state, each time it is administered. The HYS is overseen by the HYS Planning Committee, a collaborative group of state agency representatives.³⁵ The committee is currently considering plans to pilot test an electronic version of the survey.³⁶ An electronic version of the HYS would offer much greater flexibility to introduce revisions than a paper-based survey, among numerous other advantages.

Currently, the paper-based version of the survey is administered in three separate versions to administer a larger set of items across the entire sample. An electronic survey would present fewer logistical difficulties in fielding multiple versions of the survey, offering more flexibility for introducing new or additional items.

Other advantages of electronic administration include greater flexibility in posing questions

that are applicable to only certain respondents. For example, questions about what type of marijuana one uses are not applicable to someone who has never used marijuana. In a paper survey, all respondents see all questions, but electronic surveys can determine which questions to ask based on prior responses. Such adaptive questioning ensures that new items addressing additional aspects of cannabis use do not increase the length of the survey for all respondents, only those respondents who report using marijuana. Adaptive questioning increases usability for all respondents and can also address concerns about exposing naïve respondents to drug information. Electronic administration also offers better capacity to clarify questions; prompts can be added to increase attention to definitions and images can be easily incorporated.

After the initial costs of developing the electronic version of the survey, data collection can be expected to be much less costly. Current expectations are that the electronic survey would be completed using existing school computers. The cost of producing surveys, distributing them to schools, retrieving them, and digitizing them could be entirely eliminated, and unlike a paper survey, the cost of each additional completed survey would be negligible.

On the downside, transitioning to electronic administration will be a major undertaking, and in place of the logistical difficulties of paper survey administration there could be technical difficulties that could interrupt data collection, such as problems with hardware, software, or network functionality.

³⁵ Department of Health (DOH), Health Care Authority's Division of Behavioral Health and Recovery (DBHR), Liquor and Cannabis Board (LCB), and Office of the Superintendent of Public Instruction (OSPI).

³⁶ Based on conversations with HYS Planning Committee members.

Sampling

The HYS is typically not administered in certain types of schools—private schools, online schools, schools in correctional facilities, and home schools.³⁷ One potential improvement to the HYS would be to expand sampling to include students not attending public schools. This may be more feasible if and when the survey can be administered electronically.

Although we have focused on revisions to the HYS, we did consider the possibility of modifying the sample of another existing survey, the Washington Young Adult Health Survey (YAHS). The sampling procedure of the YAHS currently targets 18 to 25 year olds using random sampling of drivers who are licensed by the Washington Department of Licensing. This random sample is supplemented by additional sampling through social media. The target age range of the YAHS could be modified to recruit younger respondents. One limitation of the HYS sample is that it omits students who are not in school, an area where an expansion of the YAHS could complement information from the HYS.

If the YAHS sample were extended, the content of the survey for that portion of the sample could be freely determined by the latest research and measurement approaches. This approach would capitalize on the existing capacity of the YAHS research team to recruit participants, collect data using internet-based measurement, and follow participants over time. One difficulty with adapting the YAHS to a younger population would be obtaining

informed consent. Parental consent is typically obtained for research participants younger than 18, particularly when data collection includes identifying information, as is the case for the YAHS which tracks respondents over time. Obtaining parental consent for youth participants using internet-based data collection is a technical challenge that would need to be resolved if this approach were used.

We also considered the option of purchasing access to panel samples. Panel samples are existing pools of respondents that can be readily accessed for survey data collection. This option would allow greater flexibility in survey construction than revision of an existing survey, while being less resource intensive than initiating an entirely new data collection effort. Such panels are a service provided by companies that maintain access to potential respondents and can readily draw a sample and field a survey. As with any sample, the extent to which the sample represents the population of interest is a key consideration. Existing panels tend to be weaker in their ability to represent populations of interest than samples drawn randomly from the population of interest for a specific study.³⁸ However, sample quality varies among existing panels, and high-quality panel samples are available.³⁹

³⁷ Some of these types of schools have participated, but they are not actively recruited.

³⁸ Krosnick, J., van den Brakel, J., & Bruggen, E. (2016). *Establishing the accuracy of online panels for survey research*. Statistics Netherlands.

³⁹ The International Cannabis Policy Survey (Hammond et al. 2018), reviewed earlier in this report, uses a randomly selected panel sample.

IV. Summary

The 2018 Legislature directed WSIPP to “examine current data collection methods measuring use of cannabis by youth and report to the legislature on potential ways to improve data collection and comparisons.”⁴⁰

In responding to this assignment, WSIPP focused on the Washington Healthy Youth Survey (HYS), the primary source of data on youth marijuana use in Washington. The HYS is a principal component of Washington’s capacity to monitor youth well-being across the state. HYS data are used to plan prevention and intervention services throughout Washington communities, to evaluate the effects of programs and policies, and to conduct academic research.

We examined the HYS along three key dimensions of survey data collection methods:

- Survey construction,
- Mode of administration, and
- Sampling.

We focused primarily on survey construction, considering the aspects of marijuana use that are currently addressed in the HYS and how they are addressed. Survey measurement of marijuana use is in an early stage of development, though in the case of the HYS, numerous improvements have been made to items addressing marijuana use since legalization in 2012.

To inform our consideration of further improvements we reviewed the literature on harms of marijuana use and how use has been measured in those studies. We then examined five recently developed surveys that reflect the state of the art in survey measurement of marijuana use, and we identified common elements of these surveys that are potentially applicable to the HYS. We also spoke to a number of experts familiar with the HYS or with marijuana measurement more generally.

We identified a series of improvements to the item content of the HYS which can be expected to increase the usefulness of the HYS as a tool for monitoring and promoting youth well-being. The most feasible improvements included the following:

- Clearly defining “marijuana;”
- Distinguishing youth who use for medical purposes;
- Measuring product type and method of consumption separately;
- Measuring frequency of use over the past year;
- Measuring age of initiation of regular use; and
- Measuring most recent use.

Although changes to existing items run the risk of diminishing comparability of data over time and to different locations, we also considered practical strategies to preserve such comparisons. Survey measurement approaches for marijuana use appear to be evolving rapidly, so maintaining alignment with external approaches while making necessary improvements will be an ongoing challenge.

⁴⁰ ESSB 6032.

One of the major difficulties of interpreting survey data on marijuana use before and after legalization is that increases in reported marijuana use may reflect actual increases in use, or increases in willingness to respond honestly as a result of increasing social acceptance of cannabis use. A study comparing a survey measure of marijuana use against biochemical testing, before and after legalization, would be extremely valuable in determining the extent to which changes in survey data on marijuana use reflect changes in honesty or changes in actual use.

Although we focused our examination on the item content of the HYS, we also explored several other areas for potential improvement. These included the following:

- Electronic administration of the HYS;
- Expansion of another existing survey, the Washington YAHS to a younger sample; and
- Purchasing access to existing panels of survey respondents as an alternative approach to sampling.

Of these options, electronic administration of the HYS is a particularly promising prospect, because it offers more flexibility to incorporate revisions to the HYS than the current paper survey does, among many other advantages of electronic survey administration.

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Appendices

Measuring Youth Cannabis Use in Washington State

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I. Outcomes Associated with Marijuana Use from NAS Review

Summary of selected outcome areas from the review of health effects of cannabis by the National Academy of Sciences:

Driving. The NAS review found substantial evidence that cannabis use is associated with increased risk of motor vehicle crashes.⁴¹ In reviewed studies, cannabis use was typically measured by laboratory tests of blood or urine that could indicate acute cannabis use (i.e., use in the past three hours) or less recent use (e.g., use in the past week) that does not amount to current intoxication.

Cognition. The NAS review found moderate evidence of an association between acute cannabis use (i.e., use in the past three hours) and impairment in learning, memory, and attention.⁴²

Psychosocial. The NAS review noted that “cannabis use during adolescence is related to impairments in subsequent academic achievement and education, employment and income, and social relationships and roles,”⁴³ although it found “limited” evidence for all three categories of outcomes. Due to their relevance to youth prevention, we focused on academic achievement and social functioning (e.g., delinquency, contact with the criminal justice system). The NAS finding of limited evidence of association between cannabis use and academic achievement and social functioning was based in part on a systematic review that included studies measuring cannabis use as initiation before age 15, weekly use before 18, daily use before 15, weekly use, or cumulative use on 50 or more occasions.⁴⁴

Psychosis. The NAS review found substantial evidence of an association between cannabis use and schizophrenia and other psychoses.⁴⁵ This conclusion was based primarily on a meta-analysis that established a dose-response relationship between the intensity of cannabis use and psychosis-related outcomes—that is, the risk of psychosis was greater among cannabis users than non-users and was greatest among the most intensive marijuana users.⁴⁶ Among the various studies included in the meta-analysis, the measurement of intensive use varied, including weekly, near daily, and daily use; use more

⁴¹ NAS (2017), p. 227.

⁴² NAS (2017), p. 268.

⁴³ NAS (2017), p. 276.

⁴⁴ Macleod, J., Oakes, R., Copello, A., Crome, I., Egger, M., Hickman, M., . . . Davey Smith, G. (2004). Psychological and social sequelae of cannabis and other illicit drug use by young people: A systematic review of longitudinal, general population studies. *Lancet*, 363(9421), 1579–1588.

⁴⁵ NAS (2017), p. 291.

⁴⁶ Marconi, A., Di Forti, M., Lewis, C.M., Murray, R.M., & Vassos, E. (2016). Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophrenia Bulletin*, 42(5), 1268-1269.

than three times per year before age 15; cumulative lifetime use of 50 occasions or more and six years duration or more; and cannabis dependence. The meta-analysis did not include studies examining effects of cannabis potency on psychosis risk, but other studies have provided evidence that higher potency cannabis increases psychosis risk.⁴⁷

Depression. The NAS review also found moderate evidence that marijuana use is associated with increased risk of depressive disorder.⁴⁸ This conclusion was based largely on a systematic review that found evidence of a dose-response relationship—the increased risk of depressive disorder associated with marijuana use was greatest among heavy marijuana users.⁴⁹ Among the various studies in the review, heavy use was measured as weekly or more frequent use in the past month, or five or more occasions of use per month over a five-year period.

Suicidality. The NAS review found moderate evidence of a relationship between cannabis use and suicidal ideation, attempt, and completion and also found evidence of a dose-response relationship—heavy cannabis use was associated with even larger risk of ideation and attempt than any cannabis use.⁵⁰ Among the studies included in meta-analyses supporting these conclusions, heavy cannabis use was measured as lifetime use of 40 or more times, clinically disordered use, six or more use occasions per month, ten or more use occasions in the past year, or daily use.

Social anxiety disorder. The NAS review found moderate evidence of an association between marijuana use and social anxiety disorder. This relationship was specific to regular cannabis use, defined as daily or near-daily cannabis use.⁵¹

Progression to substance use disorder. NAS found substantial evidence that earlier initiation of cannabis use and increasing frequency of use are associated with greater likelihood of developing a cannabis use disorder.⁵² The review also found moderate evidence that cannabis use is associated with increased risk of disordered use of other substances, such as alcohol, tobacco, and illicit drugs other than marijuana. These effects were more pronounced among youth and included evidence of a dose-response relationship.

⁴⁷ Di Forti, M., Marconi, A., Carra, E., Fraietta, S., Trotta, A., Bonomo, M., . . . Murray, R.M. (2015). Proportion of patients in South London with first-episode psychosis attributable to use of high potency cannabis: A case-control study. *The Lancet Psychiatry*, 2(3), 233–238 and Di Forti, M., Quattrone, D., Freeman, T.P., Tripoli, G., Gayer-Anderson, C., Quigley, H., . . . Murray, R.M. (2019). The contribution of cannabis use to variation in the incidence of psychotic disorder across Europe (EU-GEI): A multicenter case control study. *Lancet Psychiatry*, 6(5), 427–436.

⁴⁸ NAS (2017), p. 307.

⁴⁹ Lev-Ran, S., Le Foll, B., McKenzie, K., George, T.P., & Rehm, J. (2012). Bipolar disorder and co-occurring cannabis use disorders: Characteristics, co-morbidities and clinical correlates. *Psychiatry Research*, 209, 459–465.

⁵⁰ NAS (2017), p. 311.

⁵¹ NAS (2017), p. 314.

⁵² NAS (2017), p. 334. The NAS review also examined a variety of other risk and protective factors for development of cannabis use disorder (e.g., gender, other drug use). See [Chapter 13](#) of the review for more in-depth treatment of risk and protective factors for problem cannabis use.

II. External Links to Surveys

Links to the surveys reviewed in this report are provided with permission from the authors.

- [Washington Health Youth Survey \(HYS\)](#)—Healthy Youth Survey Planning Committee (2018)
- [Canadian Cannabis Survey \(CDNCS\)](#)—Health Canada (2018)
- [Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory \(DFAQ-CU\)](#)—Cuttler & Spradlin (2017)
- [International Cannabis Policy Survey \(ICPS\)](#)—Hammond et al. (2018)
- [Washington Young Adult Health Survey \(YAHS\)](#)—Kilmer, J.R. et al. (2018)
- [Cannabis Consumption Survey \(CCS\)](#)—Kilmer, B. et al. (forthcoming)

If you are not able to obtain surveys from the links above, please contact the author of this report.

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