Adult Marijuana Use: Cognitive and Neurological Effects (1)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
Memory impairments	Substantial evidence that adults who use marijuana heavily are more likely than nonusers to have memory impairments for at least 7 days after last use.[1]		Long-term heavy cannabis users show impairments in memory and attention that endure beyond the period of intoxication and worsen with increasing years of regular cannabis use.[2] Persistent cannabis use was associated with neuropsychological decline broadly across domains of functioning, even after controlling for years of education.[3] Heavy cannabis users often demonstrate poorer decision-making and risk-taking, which have been reported alongside functional brain alterations that may	Heavy use of marijuana is associated with impaired memory, persisting a week or more after quitting.

Adult Marijuana Use: Cognitive and Neurological Effects (2)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
			persist even after 28 days of abstinence.[4] The most enduring and detectable neurocognitive deficits are seen in heavy cannabis users in the realms of decision-making, and concept formation and planning.[5]	
Acute psychotic symptoms	Substantial evidence that THC intoxication can cause acute psychotic symptoms, which are worse at higher doses.[6]		Large doses of THC produce confusion, amnesia, delusions, hallucinations, anxiety, and agitation.	Use of THC, a component of marijuana, can cause acute psychotic symptoms during intoxication.
Symptoms or diagnosis of depression	Moderate evidence that adults who use marijuana regularly are more likely than non-users to have symptoms or diagnosis of depression.[7]			Regular use of marijuana is associated with future symptoms or diagnosis of depression.

Adult Marijuana Use: Cognitive and Neurological Effects (3)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	RAND Report, 2015 (p. 33-38)	Oregon: Washington County Review article, 2014 (p. 28-32)	Oregon Public Health Division Approved Statements

Adult Marijuana Use: Cognitive and Neurological Effects (4)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
Symptoms or diagnosis of anxiety	Limited evidence that adults who use marijuana are more likely than non-users to have symptoms or diagnosis of anxiety.[8]		Anxiety reactions and panic attacks are the symptoms most frequently associated with cannabis use. Frequent cannabis users consistently have a high prevalence of anxiety disorders and patients with anxiety disorders have relatively high rates of cannabis use. About 20-30% of users show brief acute anxiety reactions after smoking the drug.[9]	Regular use of marijuana may be associated with future symptoms or diagnosis of anxiety.

Adult Marijuana Use: Cognitive and Neurological Effects (5)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
Acute anxiety symptoms		In 2011, marijuana accounted for 38% of ED visits in which illicit drugs were mentioned.[10] The most common stated reason for these visits is "unexpected reaction" which is usually a transient panic attack brought on by extreme intoxication.[11]		
Symptoms or diagnosis of psychosis	Limited evidence that adults who use marijuana are more likely than non-users to have symptoms or diagnosis of psychosis, and increasing likelihood with greater marijuana use.[12]	..is there a statistical association between marijuana an experiencing psychotic symptoms? Yes, and it has been replicated many times and in many different populations, using many different ways of operationalizing both drug use and mental illness.[13]	…in a recent retrospective study of substance-induced psychotic disorders, only cannabis and alcohol were implicated as causative agents of psychosis.[14]	Regular use of marijuana may be associated with future symptoms or diagnosis of psychosis.

Adult Marijuana Use: Cognitive and Neurological Effects (6)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
		…if cannabis use does have a causal impact on psychosis, it appears to be highly contingent on the timing and intensity of cannabis use and possibly on a genetic propensity or other existing personal and environmental risk factors.[15]		
Diagnosis of schizophrenia			Chronic use of marijuana may precipitate schizophrenia in vulnerable individuals. Meta-analytical studies have estimated that 8-14% cases [sic] of schizophrenia may be due to cannabis use.[16]	

Adult Marijuana Use: Cognitive and Neurological Effects (7)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
Mental Illness		…in numerous longitudinal studies, the temporal patterns of the association is usually more consistent with the marijuana-use-leads-to-mental-illness model than with a self-medication account.[17] …researchers have been unable to rule out the possibility that the association between marijuana use and psychotic symptoms is due to some common risk factor.[18]		
Impaired decision making	Limited evidence that adults who use marijuana regularly are more likely than non-users to have impaired decision-making for up to 2 days without use.[19]			

Adult Marijuana Use: Cognitive and Neurological Effects (8)—APPROVED STATEMENTS

	Evidence Reviews			APPROVED STATEMENTS
	Colorado Report Review Article, 2014 (p. 119-124; A139-A155)	**RAND Report, 2015 (p. 33-38)**	**Oregon: Washington County Review article, 2014 (p. 28-32)**	**Oregon Public Health Division Approved Statements**
Impaired executive functioning	Mixed evidence for whether or not adults who use marijuana are more likely than non-users to have impaired executive functioning, after not using for a short time.[20]			
Impairment of memory or other cognitive functions	Mixed evidence for whether or not adults who use marijuana heavily are more likely than non-users to have impairment of memory or other cognitive functions for at least 28 days after last use.[21]			

REFERENCES

Adult Marijuana Use: Cognitive and Neurological Effects (9)—APPROVED STATEMENTS

[1] (1) Pope, H.G., et al., *Neuropsychological Performance in Long-term Cannabis Users*. Archives of General Psychiatry, 2001. 58(10): p. 909-909.
(2) Solowij, N., et al., *Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment.* JAMA, 2002. 287(9): p. 1123-1131.
(3) Bolla, K.I., et al., *Dose-related neurocognitive effects of marijuana use.* Neurology, 2002. 59(9): p. 1137-43.
(4) Roebke, P.V., et al., *Verbal learning in marijuana users seeking treatment: a comparison between depressed and non-depressed samples.* Am J Drug Alcohol Abuse, 2014: p. 1-6.
(5) Thames, A.D., N. Arbid, and P. Sayegh, *Cannabis use and neurocognitive functioning in a non-clinical sample of users.* Addict Behav, 2014. 39(5): p. 994-9.
(6) Sanchez-Torres, A.M., et al., *Lifetime cannabis use and cognition in patients with schizophrenia spectrum disorders and their unaffected siblings.* European Archives of Psychiatry and Clinical Neuroscience, 2013. 263(8); P. 643-653.
(7) Rodgers, j., et al., *Differential effects of Ecstasy and cannabis on self-reports of memory ability: a web-based study.* Hum Psychopharmacol, 2001. 16(8): p. 619-625.
(8) Tamm, L., et al., *Impact of ADHD and cannabis use on executive functioning in young adults.* Drug Alcohol Depend, 2013. 133(2): p. 607-14.

[2] Solowij, N., et al., *Cognitive functioning of long-term heavy cannabis users seeking treatment.* JAMA, 2002. 287(9): p. 1123-31.

[3] Meier, M.H., et al., *Persistent cannabis users show neuropsychological decline from childhood to midlife.* Proc Natl Acad Sci USA, 2012. 109(40): p. E2657-64.

[4] (1) Crean, R.D., N.A. Crane, and B.J. Mason, *an evidence based review of acute and long-term effects of cannabis use on executive cognitive functions*. J Addict Med, 2011. 5(1): p. 1-8.
(2) Crane, N.A., et al., *Effects of cannabis on neurocognitive functioning: recent advances, neurodevelopmental influences, and sex differences.* Neuropsychol Rev, 2013. 23(2): p. 117-37.

[5] Crean, R.D., N.A. Crane, and B.J. Mason, *an evidence based review of acute and long-term effects of cannabis use on executive cognitive functions*. J Addict Med, 2011. 5(1): p. 1-8.

[6] (1) D'Souza, D.C., et al., *The psychotomimetic effects of intravenous delta-9-tetrahydrocannabinol in healthy individuals: implications for psychosis.* Neuropsychopharmacology, 2004. 29(8): p. 1558-72.
(2) Morrison, P.D., et al., *The acute effects of synthetic intravenous Delta9-tetrahydrocannabinol on psychosis, mood and cognitive functioning.* Psychol Med, 2009. 39(10): p. 1607-16.
(3) Morrison, P.D. and J.M. Stone, *Synthetic delta-9-tetrahydrocannabinol elicits schizophrenia-like negative symptoms which are distinct from sedation*. Hum Psychopharmacol, 2011. 26(1): p. 77-80.

[7] (1) Lev-Ran, S., et al., *The association between cannabis use and depression: a systematic review of meta-analysis of longitudinal studies.* Psychol Med, 2014. 44(4): p. 797-810.
(2) Pacek, L.R., S.S. Martins, and R.M. Crum, *The bidirectional relationships between alcohol, cannabis, co-occurring alcohol and cannabis use disorders with major depressive disorder: results from a national sample.* J Affect Disord, 2013. 148*203): p. 188-95.

[8] Kedzior, K.K. and L.T. Laeber, *A positive association between anxiety disorders and cannabis use or cannabis use disorders in the general population – a meta-analysis of 31 studies.* BMC Psychiatry, 2014. 14(4): p. 319-27.

[9] (1) Hall, W. and N. Solowij, *Adverse effects of cannabis.* Lancet, 1998. 352(9140): p. 1611-6.
(2) Crippa, J.A., et al., *Cannabis and anxiety: a critical review of the evidence.* Hum Psychopharmacol, 2009. 24(7): p. 515-23.

[10] Substance Abuse and Mental Health Services Administration, Drug Abuse Warning Network, 2011: National Estimates of Drug-Related Emergency Department Visits, Rockville, MD., HHS Publication (SMA) 13-4760, DAWN Series D-39, 2013a. As of December 13, 2014: http://www.samhsa.gov/data/sites/default/files/DAWN2k11ED/DAWN2k11ED/DawN2k11ED.pdf

[11] Kissin, W., and Ball J., *Marijuana-Related Emergency Department Visits by Youth*, Drug Abuse Warning Network Report, Rockville, MD.: Substance Abuse and Mental Health Services Administration, US Department of Health and Human services, August 2003.

[12] van Os, J., et al., *Cannabis use and psychosis: a longitudinal population-based study.* Am J Epidemiol, 2002. 156(4): p. 319-27.

[13] (1) Donoghue, K., et al., *Cannabis use, gender and age of onset of schizophrenia: data from the AESOP Study*, Psychiatry Research, 2014, 215(3): p. 528-32.
(2) Hall, W., *Is Cannabis Use Psychotogenic?* Lancet, 2006, 361(9506); p. 193-5.
(3) Hall, W., *What has research over the past two decades revealed about the adverse health effects of recreational cannabis use?*, Addiction, 2014.

Adult Marijuana Use: Cognitive and Neurological Effects (10)—APPROVED STATEMENTS

---

(4) Large, M., et al., *Cannabis use and earlier onset of psychosis: a systematic meta-analysis*, Archives of General Psychiatry, 2011, 68(6): p. 555-61.
(5) McLaren, J., et al., *Assessing evidence for a causal link between cannabis and psychosis: a review of cohort studies*, International Journal of Drug Policy, 2010, 21(1) p. 10-19.
(6) Proal, A.C., et al., *A controlled family study of cannabis users with and without psychosis*, Schizophrenia research, 2014, 1542(1): p. 283-288.
(7) Radhakrishnan R., Wilkinson, S. T., and D'Souza, D.C., *Gone to pot: a review of the association between cannabis and psychosis*, Frontiers in Psychiatry, 2014, 5, Art. 54.

[14] Aggarwal, M., et al., *Substance-induced psychotic disorders: 13-year data from a de-addiction centre and their clinical implications.* Asian J Psychiatr, 2012. 5(3): p. 220-4.

[15] (1) Hall, W., IIs Cannabis Use Psychotogenic*?* Lancet, 2006, 361(9506); p. 193-5.
(2) Hall, W., *What has research over the past two decades revealed about the adverse health effects of recreational cannabis use?*, Addiction, 2014.
(3) Proal, A.C., et al., *A controlled family study of cannabis users with and without psychosis*, Schizophrenia research, 2014, 1542(1): p. 283-288.

[16] (1) Hall, W. and N. Solowij, *Adverse effects of cannabis.* Lancet, 1998. 352(9140): p. 1611-6.
(2) Radhakrishnan R., Wilkinson, S. T., and D'Souza, D.C., *Gone to pot: a review of the association between cannabis and psychosis*, Frontiers in Psychiatry, 2014, 5, Art. 54.

[17] (1) Hall, W., IIs Cannabis Use Psychotogenic*?* Lancet, 2006, 361(9506); p. 193-5.
(2) Hall, W., *What has research over the past two decades revealed about the adverse health effects of recreational cannabis use?*, Addiction, 2014.

[18] Lewis, G., Heron, J., and Zammit, S., *Commentary on Griffith-Lendering et al (2013): cross-lagging cannabis and psychosis vulnerability*, Addiction, 2013, 108(4): p. 741-42.

[19] (1) Tamm, L., et al., *Impact of ADHD and cannabis use on executive functioning in young adults.* Drug Alcohol Depend, 2013. 133(2): p. 607-14.
(2) Fridberg, D.J., et al., *Cognitive Mechanisms Underlying Risky Decision-Making in Chronic Cannabis Users. J Math Psychol, 2010. 54(1): p. 28-38.*

[20] (1) Solowij, N., et al., *Cognitive Functioning of Long-term Heavy Cannabis Users Seeking Treatment.* JAMA, 2002. 287(9): p. 1123-1131.
(2) Bolla, K.I., et al., *Dose-related neurocognitive effects of marijuana use.* Neurology, 2002. 59(9): p. 1137-43.
(3) Thames, A.D., N. Arbid, and P. Sayegh, *Cannabis use and neurocognitive functioning in a non-clinical sample of users.* Addict Behav, 2014. 39(5): p. 994-9.
(4) Sanchez-Torres, A.M., et al., *Lifetime cannabis use and cognition in patients with schizophrenia spectrum disorders and their unaffected siblings.* European Archives of Psychiatry and Clinical Neuroscience, 2013. 263(8); P. 643-653.

[21] (1) Pope, H.G., et al., *Neuropsychological Performance in Long-term Cannabis Users*. Archives of General Psychiatry, 2001. 58(10): p. 909-909.
(2) Bolla, K.I., et al., *Dose-related neurocognitive effects of marijuana use.* Neurology, 2002. 59(9): p. 1137-43.
(3) Thames, A.D., N. Arbid, and P. Sayegh, *Cannabis use and neurocognitive functioning in a non-clinical sample of users.* Addict Behav, 2014. 39(5): p. 994-9.
(4) Smith, M.J., et al., *Cannabis-related working memory deficits and associated subcortical morphological differences in healthy individuals and schizophrenia subjects.* Schizophr Bull, 2014. 40(2): p. 297-99.