

# Medical Marijuana Science and Studies

Following are excerpts from numerous studies showing the medical efficacy of marijuana and its active components, known as cannabinoids, for a wide array of medical conditions, including cancer, HIV, multiple sclerosis, and glaucoma. Also included are scientific findings refuting some long-held beliefs about potential health hazards posed by marijuana use, most notably in relation to cancer and neurotoxicity. This is merely a representative sample of the large body of scientific evidence on the subject; it is not a comprehensive list.

Due to government interference and restrictions placed on the use of the actual marijuana plant for scientific studies in the U.S., a large number of these studies were able to examine only the medical efficacy of component compounds extracted from marijuana or, in some instances, synthetic versions of those compounds. Additional clinical trials, which would require the lifting of governmental roadblocks, are especially desirable in view of the current availability of vaporizers, which allow use of whole marijuana without the potential dangers of smoking.

## **Medical Marijuana Recommended for Selective Use by National Institute of Medicine Investigator:**

"[W]e concluded that there are some limited circumstances in which we recommend smoking marijuana for medical uses."

— Principal Investigator John Benson, National Academy of Sciences' Institute of Medicine news conference for release of study "Marijuana and Medicine: Assessing the Science Base," March 1999

## **Effective Pain Inhibitor:**

"The clinical potential of the cannabinoids is large; some people suggest that cannabis could be 'the aspirin of the 21st century' ... Cannabinoids inhibit pain in virtually every experimental pain paradigm."

— Baker, David, et al., "The Therapeutic Potential of Cannabis," *The Lancet Neurology*, May 2003

## **Therapeutic Benefits for MS and Neuropathic Pain:**

"[R]ecent randomised controlled clinical trials have pointed to potential therapeutic benefits of cannabinoids for patients with MS and chronic neuropathic pain. This suggests that patients' reports of the effectiveness of cannabis ... could serve as a valid indicator of target diseases and symptoms for cannabinoid drug development."

— Ware, M.A., et al., "The Medicinal Use of Cannabis in the UK: Results of a Nationwide Survey," *International Journal of Clinical Practice*, March 2005

### **Marijuana Eases Peripheral Neuropathy in Placebo Trial:**

"Smoked cannabis was well tolerated and effectively relieved chronic neuropathic pain from HIV-associated sensory neuropathy."

— Abrams, D., et al., "Cannabis in painful HIV-associated sensory neuropathy: A randomized placebo-controlled trial," *Neurology*, February 13, 2007

### **NIDA-Funded Epidemiological Study Shows No Detectable Marijuana Use and Cancer Correlation:**

"Contrary to our expectations, we found no positive associations between marijuana use and lung or UAT cancer."

"Associations of marijuana use with the study cancers are not strong and may be below detectable limits for this type of study."

— Tashkin, D., et al., "Marijuana Use and the Risk of Lung and Upper Aerodigestive Tract Cancers: Results of a Population-Based Case-Control Study," *Cancer Epidemiology Biomarkers & Prevention*, October 2006

### **Associated with Improved Quality of Life for Patients:**

"Cannabis smoking, even of a crude, low-grade product, provides effective symptomatic relief of pain, muscle spasms, and intraocular pressure elevations in selected patients failing other modes of treatment. These clinical cannabis patients are able to reduce or eliminate other prescription medicines and their accompanying side effects; Clinical cannabis provides an improved quality of life in these patients."

— Russo, Ethan, et al., "Chronic Cannabis Use in the Compassionate Investigational New Drug Program: An Examination of Benefits and Adverse Effects of Legal Clinical Cannabis," *Journal of Cannabis Therapeutics*, 2002

### **Medical Marijuana Benefits Related to ALS:**

"[M]arijuana has now been shown to have strong antioxidative and neuroprotective effects, which may prolong neuronal cell survival. From a pharmacological perspective, marijuana is safe with minimal possibility of overdose. In states where it is legal to do so, marijuana should be considered in the pharmacological management of ALS."

— Carter, Gregory T. Rosen, Bill S., "Marijuana in the Management of Amyotrophic Lateral Sclerosis," *American Journal of Hospice and Palliative Care*, July/August 2001

### **More Reported Medical Marijuana Benefits Related to ALS:**

"The results indicate that cannabis may be moderately effective at reducing symptoms of appetite loss, depression, pain, spasticity, and drooling."

— Amtmann, Dagmar, et al., "Survey of Cannabis Use in Patients With Amyotrophic Lateral Sclerosis," *American Journal of Hospice & Palliative Medicine*, March/April 2004

### **Promising Research with Cannabinoid Receptors and ALS:**

"There is rapidly emerging evidence that the cannabinoid receptor system has the potential to reduce both excitotoxic and oxidative cell damage ... [delta-9-THC] delays progression of disease and increases survival time ... even when administered after onset of signs." The authors found that delta-9-THC is both anti-excitotoxic and antioxidant in vitro.

— Raman, Chandrasekaran, et al., "Amyotrophic Lateral Sclerosis: Delayed Disease Progression in Mice by Treatment with a Cannabinoid," *Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders*, March 2004

### **Vaporization of Marijuana Reduces Potential Harmful Compounds**

"[Cannabinoids] will vaporize at a temperature much lower than actual combustion. Heated air can be drawn through marijuana and the active compounds will vaporize, which can then be inhaled ... Theoretically, this removes most of the health hazards of smoking."

— Carter, Gregory T. Rosen, Bill S., "Marijuana in the Management of Amyotrophic Lateral Sclerosis," *American Journal of Hospice and Palliative Care*, July/August 2001

### **Vaporization of Marijuana Reduces Harmful Byproducts:**

"Vaporization offers patients who use medical cannabis the advantages of the pulmonary routes of administration ... while avoiding the respiratory disadvantages of smoking."

"Using the Volcano device for the pulmonary administration of THC, a delivery is reached that is comparable to smoking, but without the presence of degradation products or harmful byproducts in significant amounts."

— Hazecamp, A., et al., "Evaluation of a Vaporizing Device (Volcano®) for the Pulmonary Administration of Tetrahydrocannabinol," *Journal of Pharmaceutical Sciences*, June 2006

### **Helps Facilitate ARV Therapy Adherence in HIV-Infected Patients:**

"These data suggest that medicinal use of marijuana may facilitate, rather than impede, [antiretroviral therapy] adherence for patients with nausea. ... Adherence to medications is a challenge to any chronically ill patient and is critically important to HIV-infected individuals ..."

— DeJong, Bourke, "Marijuana Use and Its Association With Adherence to Antiretroviral Therapy Among HIV-Infected Persons With Moderate to Severe Nausea," *Journal of Acquired Immune Deficiency Syndromes*, 2005

### **Facilitation of Treatment Compliance:**

"Cannabis users were significantly more likely than non-users to remain on HCV treatment for at least 80% of the projected treatment course"

— Sylvestre, D., et al., "Cannabis use improves retention and virological outcomes in patients treated for hepatitis C," *European Journal of Gastroenterology & Hepatology*, October 2006

### **Improvement in Toleration of Challenging Treatments:**

“... [O]ur results suggest that moderate cannabis use during HCV treatment may offer significant benefit to certain patients ... related to ... improvement in the tolerability of the challenging medication regimen.”

“... [W]ith legal prescriptions against cannabis use limiting its study, the design and conduct of randomized, prospective research studies is virtually impossible at this time.”

— Sylvestre, D., et al., “Cannabis use improves retention and virological outcomes in patients treated for hepatitis C,” *European Journal of Gastroenterology & Hepatology*, October 2006

### **No Association Between Marijuana and Lung Cancer:**

“We did not observe a positive association of [marijuana] use — even heavy long-term use — with lung ca[n]cer, controlling for tob[acco] smoking and other potential confounders.”

“Even lifetime use totaling 20,000 cannabis cigarettes did not result in an increase in risk of lung cancer.”

— Tashkin, D.P., et al., “Marijuana Use and Lung Cancer: Results of a Case-Control Study,” presentation at the 2005 meeting of the International Cannabinoid Research Society Conference, 2005

### **Possible Protective Effect Against Cancers:**

“Although purely speculative, it is possible that such inverse associations may reflect a protective effect of marijuana.”

— Tashkin, D., et al., “Marijuana Use and the Risk of Lung and Upper Aerodigestive Tract Cancers: Results of a Population-Based Case-Control Study,” *Cancer Epidemiology Biomarkers & Prevention*, October 2006

### **Decreased Tumor Burden in Leukemia Cells Exposed to Cannabidiol:**

“Exposure of leukemia cells to cannabidiol led to CB2-mediated reduction in cell viability and induction in apoptosis ... [and] a significant decrease in tumor burden and an increase in apoptotic tumors in vivo.”

— McKallip, Robert J., et al., “Cannabidiol-Induced Apoptosis in Human Leukemia Cells: A Novel Role of Cannabidiol in the Regulation of p22phox and Nox4 Expression,” *Molecular Pharmacology*, June 5, 2006

### **Promising Anti-Tumor Effects Observed:**

“A strong and statistically significant anti-tumor effect was observed ... In particular, for a highly malignant human breast carcinoma cell line ... cannabidiol and a cannabidiol-rich extract counteract cell growth both in vivo and in vitro as well as tumor metastasis in vivo.”

— Ligresti, Alessia, et al., “Anti-Tumor Activity of Plant Cannabinoids with Emphasis on the Effect of Cannabidiol on Human Breast Carcinoma,” *Journal of Pharmacology And Experimental Therapeutics*, May 25, 2006

### **THC and Inhibition of Tumor Cell Proliferation:**

"[THC] inhibited tumour-cell proliferation in vitro and decreased tumour-cell Ki67 immunostaining."

- Guzman, M., et al., "A Pilot Clinical Study of Delta-9-tetrahydrocannabinol in Patients With Recurrent Glioblastoma Multiforme," *British Journal of Cancer*, July 2006

### **Possible Tumor Growth Inhibition:**

"There is recent evidence from cell culture systems and animal models that 9-tetrahydrocannabinol, the principal psychoactive ingredient in marijuana, and other cannabinoids may inhibit the growth of some tumors by modulating key signaling pathways leading to growth arrest and cell death, as well as inhibiting tumor angiogenesis...antitumoral associations have been observed for several types of malignancies including brain, prostate, thyroid, lung, and breast."

- Tashkin, D., et al., "Marijuana Use and the Risk of Lung and Upper Aerodigestive Tract Cancers: Results of a Population-Based Case-Control Study," *Cancer Epidemiology Biomarkers & Prevention*, October 2006

### **Palliative Benefits of Cannabinoids in Patients with Cancer:**

"Cannabinoids exert palliative effects in patients with cancer and inhibit tumor growth in laboratory animals ... Cannabinoids are selective anti-tumor compounds, as they can kill tumor cells without affecting their non-transformed counterparts."

- Guzman, Manuel, "Cannabinoids: Potential Anticancer Agents," *Nature Reviews*, October 2003

### **THC Does Not Decrease Patient Survival:**

"THC does not facilitate tumor growth nor decreases patient survival."

- Guzman, M., et al., "A Pilot Clinical Study of Delta-9-tetrahydrocannabinol in Patients With Recurrent Glioblastoma Multiforme," *British Journal of Cancer*, July 2006

### **Marijuana Unlikely to be Neurotoxic to the Adolescent Brain:**

"[N]o pattern consistent with evidence of cerebral atrophy or loss of white matter integrity was detected. It is concluded that frequent cannabis use is unlikely to be neurotoxic to the normal developing adolescent brain."

- DeLisi, Lynn E., et al., "A Preliminary DTI Study Showing No Brain Structural Change Associated With Adolescent Cannabis Use," *Harm Reduction Journal*, May 9, 2006

### **Clinical Trial Suggests Medical Marijuana Safe for Immune-Compromised Patients:**

"Our short-duration clinical trial suggests acceptable safety in a vulnerable immune-compromised patient population."

- Abrams, Donald, et al., "Short-Term Effects of Cannabinoids on Patients With HIV-1 Infection: A Randomized, Placebo-Controlled Clinical Trial," *Annals of Internal Medicine*, August 19, 2003

**Possible Modulation of Neuropathic Pain:**

"There is significant evidence that cannabinoids may be involved in the modulation of pain, especially of neuropathic origin. Preliminary results from a small, uncontrolled trial of smoked marijuana in HIV peripheral neuropathy are encouraging."

— Abrams, Donald, et al., "The Effects of Smoked Cannabis in Painful Peripheral Neuropathy and Cancer Pain Refractory to Uploads," IACM 2nd Conference on Cannabinoids in Medicine, Cologne, September 2003

**Possible Prevention of the Neurodegenerative Process of Alzheimer's:**

"Our results indicate that cannabinoid receptors are important in the pathology of [Alzheimer's Disease] and that cannabinoids succeed in preventing the neurodegenerative process occurring in the disease."

— Ramirez, Belen, et al., "Prevention of Alzheimer's Disease Pathology by Cannabinoids: Neuroprotection Mediated by Blockade of Microglial Activation," *The Journal of Neuroscience*, February 25, 2005

**Possible Prevention of Neurotransmitter Degradation:**

"AChE inhibitors such as THC and its analogues may provide an improved therapeutic for Alzheimer's disease, augmenting acetylcholine levels by preventing neurotransmitter degradation and reducing A $\beta$  aggregation, thereby simultaneously treating both the symptoms and progression of Alzheimer's disease."

— Eubanks, L., et al., "A Molecular Link between the Active Component of Marijuana and Alzheimer's Disease Pathology," *Molecular Pharmaceutics*, June 2006

**Possible Promise in Inhibition of Alzheimer's Progression:**

"THC is a considerably more effective inhibitor of AchE-induced A $\beta$  deposition than the approved drugs for Alzheimer's disease treatment..."

— Eubanks, L., et al., "A Molecular Link between the Active Component of Marijuana and Alzheimer's Disease Pathology," *Molecular Pharmaceutics*, June 2006

**Reduced Rates of Post-op Nausea and Vomiting:**

"Post-operative nausea and vomiting (PONV) is a "significant problem in breast surgical patients. Preoperative treatment with dronabinol [oral THC] and prochlorperazine significantly reduced the number and severity of episodes of PONV." The rate of nausea decreased from 59 percent to 15 percent and the rate of vomiting from 29 percent to 3 percent compared to non-treated patients."

— Layeeque, R., et al., "Prevention of Nausea and Vomiting Following Breast Surgery," *American Journal of Surgery*, June 2006

**Nausea and Vomiting Relief:**

"Patients who smoked marijuana experienced 70-100% relief from nausea and vomiting, while those who used the THC capsule experienced 76-88% relief."

— "Effects of Smoked Cannabis and Oral  $\Delta$ 9-Tetrahydrocannabinol on Nausea and Emesis After Cancer Chemotherapy: A Review of State Clinical Trials," *Journal of Cannabis Therapeutics*, 2002

**Anti-Nausea Effectiveness in Child Cancer Patients:**

"[D]elta-8-THC was effective in preventing nausea and vomiting in eight children, aged three to fifteen, who suffered from hematologic cancers. Throughout up to eight months of treatment with a variety of chemotherapeutic drugs, delta-8-THC was totally effective and had negligible side effects."

— Abrahamov, A. and Mechoulam, R., "An Efficient New Cannabinoid Antiemetic in Pediatric Oncology," *Life Sciences*, May 5, 1995

**Inhaled Marijuana Effectively Treats Nausea and Vomiting:**

"Fifty-six patients who had no improvement with standard antiemetic agents were treated and 78% demonstrated a positive response to marijuana ... inhalation marijuana is an effective therapy for the treatment of nausea and vomiting due to cancer chemotherapy."

— Vinciguerra, Vincent, et al., "Inhalation Marijuana as an Antiemetic for Cancer Chemotherapy," *New York State Journal of Medicine*, October 1988

**Medical Marijuana and Antiemetic Properties for Cancer Patients:**

"We conclude that THC is an effective antiemetic in many patients who receive chemotherapy for cancer and for whom other antiemetics are ineffective."

— Sallan, S. E., et al., "Antiemetics in Patients Receiving Chemotherapy for Cancer," *New England Journal of Medicine*, 1980

**Significantly Reduces Chemotherapy-Related Vomiting:**

"Oral tetrahydrocannabinol has antiemetic properties and is significantly better than a placebo in reducing vomiting caused by chemotherapeutic agents."

— Sallan, S.E., et al., "Antiemetic Effect of Delta-9-Tetrahydrocannabinol in Patients Receiving Cancer Chemotherapy," *New England Journal of Medicine*, 1975

**Stimulates Appetite:**

"Conclusion: THC is an effective appetite stimulant in patients with advanced cancer. It is well tolerated at low doses."

— Nelson, K., et al., "A Phase II Study of Delta-9-Tetrahydrocannabinol for Appetite Stimulation in Cancer-Associated Anorexia," *Journal of Palliative Care*, Spring 1994

### **Cannabinoids as a Safe and Effective Glioma Treatment:**

"Remarkably, cannabinoids kill glioma cells selectively and can protect non-transformed glial cells from death ... Cannabinoids have a favorable drug safety profile."

— Vasco, Guillermo, et al., "Hypothesis: Cannabinoid Therapy for The Treatment of Gliomas," *NeuroPharmacology*, January 2004

### **Potential Broad Spectrum Relief from Complex Symptoms:**

"For patients such as those with AIDS or who are undergoing chemotherapy and who suffer simultaneously from severe pain, nausea, and appetite loss, cannabinoid drugs might offer broadspectrum relief not found in any other single medication. ... In conclusion, the available evidence from animal and human studies indicates that cannabinoids can have a substantial analgesic effect."

— National Academy of Sciences' Institute of Medicine, Division of Neuroscience and Behavioral Health, "Marijuana and Medicine: Assessing the Science Base," 1999

### **Therapeutic Potential for Neurological Disorders:**

"Cannabinoids are now known to have the capacity for neuromodulation, via direct, receptor based mechanisms at numerous levels within the nervous system. These have therapeutic properties that may be applicable to the treatment of neurological disorders ... This class of compounds not only holds tremendous therapeutic potential for neurological disease, but it is also confirmed as having remarkably low toxicity."

— Carter, Gregory, et al., "Overview: Cannabis: Old Medicine With New Promise for Neurological Disorders," *Current Opinion in Investigational Drugs*, March 2002

### **Potential Benefits Related to Epilepsy:**

"The anticonvulsant nature of cannabidiol suggests that it has a therapeutic potential in at least three of the four major types of epilepsy: grand mal, cortical focal, and complex partial seizures."

— Karler, R. and Turkkanis, S.A., "The Cannabinoids as Potential Antiepileptics," *The Journal of Clinical Pharmacology*, August 1981

### **THC and Reduction of Spasticity in Small Sample:**

"For the group, 10 mg THC significantly reduced spasticity by clinical measurement."

"THC was administered to eight other patients with spasticity and other CNS lesions. Responses varied, but benefit was seen in three of three patients with 'tonic spasms.'"

— Petro, D., et al., "Treatment of Human Spasticity With Delta-9-Tetrahydrocannabinol," *The Journal of Clinical Pharmacology*, 1981

### **MS Pain Reduction:**

"Cannabinoids appear to have benefit in reducing pain in MS and other neuropathic pain syndromes."

— Chong, MS, et al., "Cannabis use in patients with multiple sclerosis," *Multiple Sclerosis*, 2006

**Pain and Spasm Relief:**

“The most commonly cited symptoms for cannabis use were pain and spasms ... and the majority of persons using it for these symptoms reported benefit.”

— Chong, M. S., et al., “Cannabis use in patients with multiple sclerosis,” *Multiple Sclerosis*, 2006

**Extended Symptom Relief Without Increased Dosage:**

“... [P]atients with MS who derive symptom relief from CBM [cannabis-based medicine] in the first 10 weeks, generally maintain that symptom relief over an extended period of treatment without any increase in dose.”

— Wade D. T., et al., “Long-term use of a cannabis-based medicine in the treatment of spasticity and other symptoms in multiple sclerosis,” *Multiple Sclerosis*, 2006

**Benefits Not Due to Intoxication:**

“The low intoxication scores ... do not suggest that the benefits reported were simply the result of patients feeling better due to intoxication.”

— Wade D. T., et al., “Long-term use of a cannabis-based medicine in the treatment of spasticity and other symptoms in multiple sclerosis,” *Multiple Sclerosis*, 2006

**Marijuana’s Active Ingredient may Help Stall Alzheimer’s Disease**

“Scientists are beginning to understand several biochemical mechanisms by which marijuana may stall the disease—perhaps even more successfully than the most frequently prescribed medications... [N]ew research reveals that the active ingredient in marijuana, tetrahydrocannabinol (THC), may outperform cholinesterase inhibitors. According to Kim D. Janda of the Scripps Research Institute in La Jolla, Calif., THC prevents the degradation of acetylcholine just as Cognex and Aricept do, and it may also hinder toxic proteins from forming plaques.”

— Klein, Andrew, “Staving off Dementia,” *Scientific American Mind*, April/May 2007

**Medical Benefit for HIV-Positive Marijuana Smokers:**

“Smoked marijuana also has clear medical benefit in HIV-positive marijuana smokers by increasing food intake and improving mood and objective and subjective sleep measures.”

— Hany, Margaret, et al., “Dronabinol and Marijuana in HIV-Positive Marijuana Smokers,” *Psychopharmacology*, March 2005

**No Increase in Use:**

“Consistent with other studies of the liberalization of cannabis laws, [this study] indicate[s] that medical cannabis laws do not increase use of the drug.”

— Gorman, D. M., Huber, J. C., “Do Medical Cannabis Laws Encourage Cannabis Use?” *International Journal of Drug Policy*, 2006

**No Increase in Use Within High Risk Sub-Groups:**

"Our results indicate that the introduction of medical cannabis laws was not associated with an increase in cannabis use among either arrestees or emergency department patients."

— Gorman, D. M., Huber, J.C., "Do Medical Cannabis Laws Encourage Cannabis Use?" *International Journal of Drug Policy*, 2006

**Medical Cannabis Held Back For Legal Reasons:**

"Cannabinoid research joins stem cell research and xenotransplantation ... on the list of potentially life-saving technologies that have been held back for legal reasons."

— Gonzaga, Rachel, "Cannabis: Medicine or Malady?" *First Science*, July 3, 2007

**Cannabinoids Useful In Hearts and Blood Vessels:**

"There is increasing experimental evidence that cannabinoid drugs may be useful in limiting damage to diseased hearts or blood vessels" (Dr. Jeremy Pearson, as cited in Gonzaga, 2007).

— Gonzaga, Rachel, "Cannabis: Medicine or Malady?" *First Science*, July 3, 2007

**Cannabinoids May Inhibit Lung Cancer Growth:**

"Our study suggests that cannabinoids like THC should be explored as novel therapeutic molecules in controlling the growth and metastasis of certain lung cancers."

— Preet, A., et al., "Tetrahydrocannabinol inhibits epithelial growth factor-induced lung cancer cell migration in vitro as well as its growth and metastasis in vivo," *Oncogene*, 2007

**Cannabinoids May Inhibit Lung Cancer Growth:**

"We have shown that THC [the active chemical in marijuana] inhibits lung cancer growth and metastasis."

— Preet, A , "Tetrahydrocannabinol inhibits epithelial growth factor-induced lung cancer cell migration in vitro as well as its growth and metastasis in vivo," *Oncogene*, 2007