Marijuana, CBD
& Vaping

DISCLAIMER: the following is not meant to treat anyone with advice or tell you what you should do, such as relative to use of medication, exercise, or changing your diet. The information in this handout is merely offering what has been published in the research literature, as well as based on my professional experience. Talk to a doctor or other appropriate professionals as to what is best for your own specific needs.

It should also be appreciated that everyone has their own perspective on how to improve health. Nutritionists do it through food. Physicians do it through medicine. Psychologists do it through changing thoughts, feelings, and behaviors. Consequently, what is offered here is a reflection of my own bias and perspective.

There is a lot of talk about medical marijuana today. A lot of states are loosening laws and making it legal, and they certainly like the extra tax revenue they can make in the process. But what is not being spoken about or recognized?

If something as innocuous as aspirin can have side effects such as ulcers and even death, marijuana can be expected to have some too. Something that many people do not know about the plant is that it has the ability to pull heavy metals like cadmium and lead out of the earth and take it into itself (phytoremediation is the fancy term used to describe this happening). Industrial hemp was used to clean up the soil after the Chernobyl nuclear plant had a meltdown. It does not take a nuclear plant catastrophe to contaminate soil. Common industrial sites such as smelting factories, mining, and the spread of lead (from such gasoline over many decades of use into the air and then the soil and water) are examples of more common means of contamination.

Phytoremediation cleans the soil but contaminates the plant. If a person then smokes the leaf or eats it as part of an edible they ingest the heavy metals. Marijuana remains illegal on a federal level and so there is no regulation of it such as for heavy metals contamination. Individual states have different regulations and there are differences among them as to what and how well heavy metals are regulated. Typically only 'the big 4' - arsenic, lead, cadmium, and mercury are regulated at all. CNN has reported that marijuana users have 27% more lead and 22% more cadmium in their blood than non-users. Such numbers came from a NHANES study between 2005-2018 involving 7,254 people who said they had used marijuana in the past month. ("Marijuana users have more heavy metals in their bodies" Sandee LaMotte, 8/31/23).

There are many other heavy metals that can contaminate the plant including

- aluminum
- antimony
- arsenic
- barium
- cesium

- chromium
- cobalt
- copper
- iron
- manganese
- mercury
- molybdenum
- nickel
- platinum
- selenium
- silver
- thallium
- thorium
- tungsten
- vanadium
- zinc

There are also pesticides that are used on them. One study done in 2016 on Washington state marijuana found 22 of 26 samples positive for such contamination including insecticides, miticides, fungicides, and growth regulators. The researcher concluded "The unregulated commerce in cannabis and lack of organic certification have resulted in widespread abuse of the legal system. These products present a clear and present danger, particularly to young patients with epilepsy and other neurological conditions." ("Pesticide contamination of cannabis in the legal market, Ethan Russo, MD.) One study (International Journal of Drug Policy, "How four U.S. states are regulating recreational marijuana edibles" Camille Gourdet et al, Jan. 2017) noted that Colorado had "several high-profile recalls of contaminated marijuana batches. These products were recalled after harmful pesticides were found in some edibles. …Growers sometimes find themselves quite overwhelmed by pest issues [and] many more resort to nuclear tactics than are willing to admit it. [This has created] a public safety threat [that] has arisen relating to application of pesticides on cannabis with intensified toxicity in concentrated products of particular concern." Another study (Frontiers in Pharmacology, "Current therapeutic cannabis controversies and clinical trial design issues" Ethan Ruso, Sept. 2016) looked at samples on store shelves in Washington state and found pesticide residues in 84.6% "including potentially neurotoxic and carcinogenic agents….Many harbored multiple contaminants attaining levels in the tens of thousands of parts per billion (ppb), exceeding the upper limit of quantification. These included 24 distinct pesticide agents of every class: insecticides, fungicides… organophosphates, organochlorides, carbamates, etc." and none are approved for use in cannabis by the EPA given that it is still a Federally illegal crop, so all pesticide use on it is currently illegal.

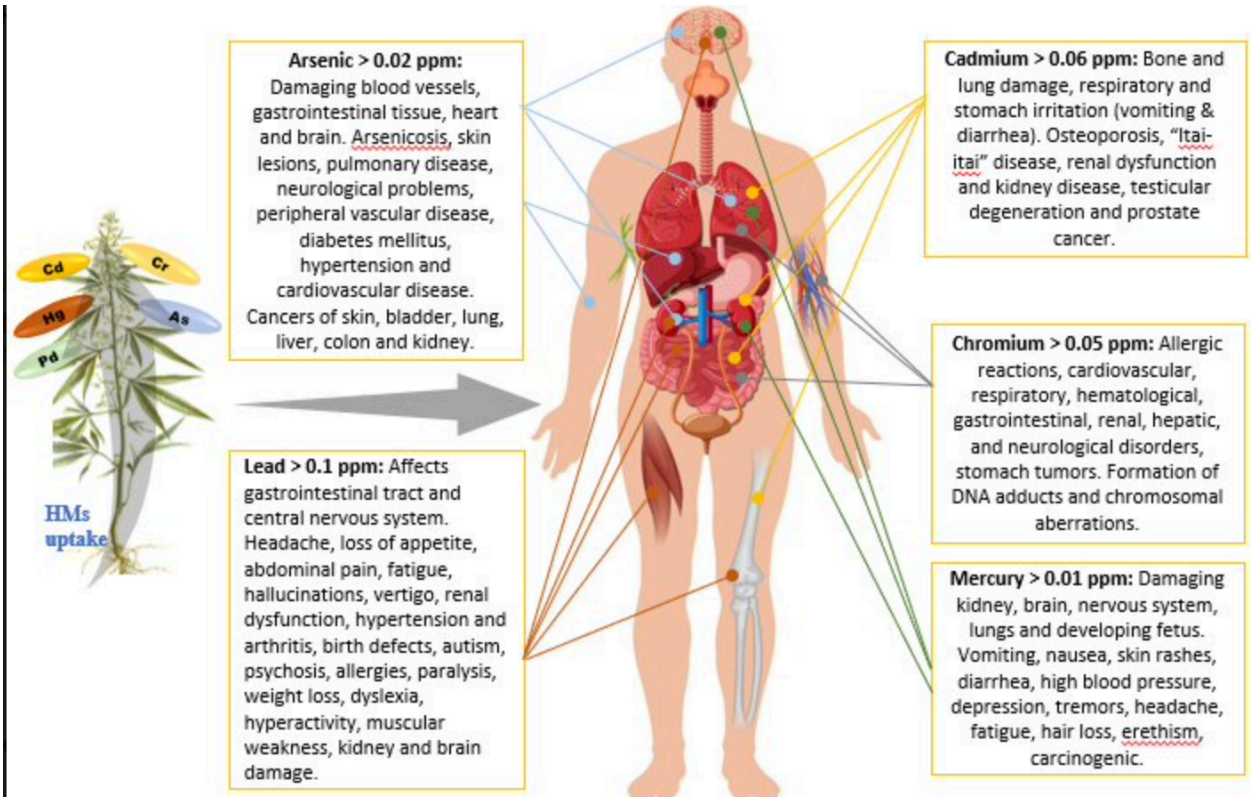
Marijuana is said to be a hyper-accumulator of cobalt, and this mineral has been listed as a carcinogen by the American Association for Cancer Research. There is also research that likens marijuana use to that of tobacco in various ways. This includes smoking it leading to five times greater absorption of carbon monoxide vs. cigarettes. Because marijuana smoke tends to be held in the lungs longer there is four times more tar deposited in them. Benzopyrene, a carcinogen, is

present in marijuana in similar amounts too cigarettes. as to increasing the risk of various cancers. The smoke is also known to damage lung tissue leading to asthma and COPD. Women who smoke it have a 2.3 times greater risk of stillbirth (NIH, "Tobacco, drug use in pregnancy can double the risk of stillbirth," 12/11/13). It may increase the risk of cancer of the mouth and tongue. It may weaken the immune system and increase the risk of leukemia and other cancers in kids whose mothers smoked it during pregnancy. There is also increased risk of testicular germ cell tumors.

Memory problems have been found among workers exposed to cobalt through inhalation. There is research done on almost 5 million live births in California through UCSD that mothers who smoke marijuana are more likely to have preterm birth and babies with low birth weight vs. those who did not have a cannabis use disorder diagnosis. The risk for infant mortality was greater too, with a 35% greater likelihood of dying within the first year of life compared to a control group. THC can reach infants both through the placenta as well as breast milk.

Another mineral that marijuana is good at extracting from soil is cadmium, and this heavy metal accumulates in the roots most and second most in the leaves. Cadmium is said to contribute to more cancers than all the other heavy metals combined. One estimate is that as many as a third of breast cancers in the U.S. may be associated with elevated cadmium levels. Beyond cancer, smoking marijuana can lead to cardiovascular disease and COPD.

Manganese is neurotoxic such as when inhaled and it is thought to be so by getting directly into the brain.



Erethism: 'Mad Hatter disease' such as referenced in 'Alice in Wonderland' from the exposure of mercury used to make felt hats.

There has been some research about long term use of marijuana and its effects on middle-aged individuals and cognitive abilities. One study (American Journal of Psychiatry, "Long-term cannabis use and cognitive reserves and hippocampal volume in midlife" Madeline Meier et al, March 2022) was done in New Zealand with over 1,000 people, starting at age 3 and going till they were 45 years old, with periodic evaluations over that time frame. Findings included long-term marijuana users having a 5.5 IQ point decline between childhood and middle-age, along with poorer learning, processing speed, and memory and attention issues according to informants. Such difficulties could not be explained by tobacco, alcohol, or other illegal drug use. Nor was it due to socioeconomic status, low childhood self-control, or family history of substance dependence. There was also smaller hippocampal volume (the area of the brain key to memory). Other research has found that the loss of IQ may be as much as 8 points if one started smoking it in adolescence.

Use of it in adolescence is said to impact the hippocampus and prefrontal cortex (the area that separates humans from 'lower animals' as to the ability to think, reason, be moral, etc.), and thus impacting one's cognitive abilities as well as the regulation of emotions and social behavior. Research done at McLean Hospital outside of Boston found that marijuana use impaired driving ability even when the user was not under the influence of it. Users had more accidents, drove at higher speeds, and drove through more red lights than non-users. Getting into regular use of marijuana prior to the age of 16 was associated with poor driving performance too possibly due to increased impulsivity. (Mass General Brigham McLean, "McLean study finds marijuana use impacts driving even when sober" 1/14/20).

There is also research from the Insurance Institute for Highway Safety (IIHS) which found that injury and fatality rates increased in California, Colorado, Nevada, and Washington in the months following the laws being relaxed in those states. The combination of marijuana and alcohol was worse as to becoming more aggressive behind the wheel such as maneuvers made or speeding on residential streets. (IIHS, "Crash rates jump in wake of marijuana legalization, new study shows" 6/17/21). There was also a meta-analysis (BMJ, "Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis" Mark Asbridge et al, 2/9/2012) found that with acute cannabis consumption "a near doubling of risk of a driver being involved in a motor vehicle collision resulting in serious injury or death." They do note that alcohol is even worse when it comes to crashes as to cannabis increasing the risk of a crash by 2-3 times while alcohol may jack it up by 6-15 fold. Combining alcohol and marijuana (Injury Epidemiology, "Interaction of marijuana and alcohol on fatal motor vehicle crash risk: a case-control study" Stanford Chihuri et al, 2017) with a 25-fold increase in risk for fatalities in a crash.

Still other health effects of marijuana include cardiovascular problems. For those who have cardiovascular disease smoking it causes chest pain to develop more quickly in that it increases the heart rate and causes the heart to pump harder. The risk of a heart attack is several times higher in the first hour after smoking marijuana than it would otherwise be. (Harvard Health Publishing, "Marijuana and heart health: what you need to know" 1/19/22). There is also a higher risk of afib or ischemic stroke immediately after smoking marijuana. And smoking it may increase the long-term death rate for those who have survived heart attacks. A research study involving ~157K adult Americans (All of Us Research Program sponsored by NIH) followed those free from heart failure at time of enrollment for 45 months. People who reported daily marijuana use had a 34% increased risk of developing heart failure compared to those who never smoked it.

There are some links to use of it with earlier onset of psychosis for those who have a genetic risk such as for schizophrenia. There may also be worse symptoms for those who already are psychotic. There is also research linked cannabis use to suicidal thoughts and behaviors in teens, and military vets. One study looked at over 281,000 adults ages 18-34 between 2008-2019. They found a 40-60% increase in suicidal thinking, planning and attempts. (JAMA Open Network, "Associations of suicidality trends with cannabis use as a function of sex and depression status" Beth Han et al, June 2021).

Then there is the concern of using cannabis during pregnancy which has risen from 3% to 7% in the past few years. A study published in JAMA Psychiatry ("Associations between prenatal cannabis exposure and childhood outcomes: results from the ABCD Study" Sarah Paul et al, 2021) looked at over 11,000 kids with 655 exposed prenatally to cannabis and found that it was "associated with greater psychopathology during middle childhood, even after accounting for potentially confounding variables. Cannabis use during pregnancy should be discouraged." Difficulties in kids who had been exposed prenatally had "more psychotic-like experiences; more problems with depression and anxiety as well as impulsivity and attention; and social problems as well as sleep disturbances. They also had lower cognitive performance, lower indices of global brain structure during middle childhood as well as lower birth weight."

(https://source.wustl.edu/2020/09/prenatal-cannabis-exposure-associated-with-adverse-outcomes-during-middle-childhood/)

One other issue to be aware of is that the strength of marijuana has increased greatly over time. Back in the '60s and '70s when it first became popular the THC strength was down around 1-2%. By 1997 it was up to close to 6%. In 2008 it was over 10%. Currently it is in the 20-25% range and some are as high as 32% THC, so less can be consumed and people will still get high quickly. There are now concentrates of it that are as high 80-90% and which are processed using solvents like propane or butane but manufacturers say they are still 'all natural.'

Marijuana edibles are said to impact younger kids and older adults the most through over consumption and accidental ingestion. Kids may end up vomiting from edibles along with impairing brain development and having poor mental health. Older adults may experience cognitive impairment, risk of falls, heart arrhythmia, and various drug interactions.

Another problem with edibles is that there can be cross-contamination such as from pests, molds, and bacteria. Mice like pot and if they get into a growing facility their urine and feces can contaminate the product. They also may carry salmonella and so that can be spread into the product. Pesticides can drift from nearby outdoor sites and cross-contaminate clean plants. Problems also can arise from processing and manufacturing facilities such as arsenic found in the oil used in the production of marijuana edibles. Employees who are ill while processing edibles can cause problems too. There can be problems with employees simply touching the product with dirty hands; health regulations that are involved with other food industries are not in place for the cannabis industry. Chemicals in the processing plant that are improperly stored might end up in the product.

Another issue with edibles is that if they contain stuff like eggs, dairy, meats, or chicken there can be food safety issues such as if they are not properly cooked to kill bacteria, or if they have been left out of the fridge for too long.

Another problem is that smoking marijuana results in quick onset, while with edibles it can take 30-60 minutes which can cause over consumption. Edibles' effects can last longer too such as with peak THC blood levels occurring about three hours after consumption.

CBD comes with similar problems. One study was done by the U. of Miami and looked at 516 CBD products, with 121 intended for oral consumption. Of the edibles, there were positive tests in:

- 42% for lead
- 37% for mercury
- 28% for arsenic
- 8% for cadmium
- phthalates varied between 13-80% across four with DEHP being the most prevalent

"Low-level contamination of edible CBD products with heavy metals and phthalates is pervasive. Heavy metal and phthalate contamination in CBD may counter-balance its proposed health

benefits." (Science of the Total Environment, "Heavy metal and phthalate contamination and labeling integrity in a large sample of US commercially available CBD products" Hannah Gardner et al, Dec. 2022).

Heavy metals also have been found in Delta-8 vapor products (Chemical Research in Toxicology, "Novel Delta-8 THC vaporizers contain unlabeled adulterants, unintended byproducts of chemical synthesis, and heavy metals" Jiries Meehan-Atrash et al, 12/10/21). U. of Rochester researchers assessed the purity of 27 e-cigarette products containing delta-8. Eleven contained "high levels of "unlabeled cutting agents" and all tested positive for heavy metals including magnesium, chromium, nickel, and mercury which were thought to be leachates from vaporized components or production materials. It is thought when inhaled they could cause respiratory problems.

Vaping

Vaping has become popular and is viewed by many as a better way of getting a nicotine hit than smoking cigarettes. But vaping is hardly healthy.

For men, vaping may lower sperm counts and have an impact on the testicles and sex drive according to some research done on rats. Human research done by Colorado U. in 2023 found that nicotine vaping was harmful to fetal health. Babies ended up with smaller and shorter bones during their development. Other research has found that vaping increases the risk of having a heart attack or stroke, based on research that looked at over 400K people across all of the States. Vapers had a 71% higher risk of stroke, 59% higher risk of heart attack or angina, and 40% greater risk of coronary heart disease, along with double the rate of cigarette smoking.

Vaping without nicotine still causes problems. Damage is done to the vascular system including the inner lining (endothelium) of blood vessels.

One issue that is becoming apparent is that there is a difference between the nicotine liquid relative to toxins in it beyond nicotine, and the vapor that is inhaled. Some of the chemicals include what are called 'volatile organic compounds' (VOC's) that can cause irritation to the eyes, nose, and throat along with damage to the kidneys, liver and nervous system. There are also flavoring chemicals some of which contain diacetyl that has been linked to a serious lung disease called bronchiolitis obliterans which entails scarring of the tiny airways in the lungs and is sometimes known as 'popcorn lung.' Ethyl maltol is often used as a caramel flavor. It has been linked to inflammation and the generation of free radicals that might cause cancer to arise. Formaldehyde (the chemical used to embalm people) which is carcinogenic, can form if e-liquid overheats or not enough of it reaches the heating element (a 'dry puff').

Then there is the heating of the liquid through a metal coil which transfers all manner of heavy metals into the vapor. Studies have found that many e-cigarette devices generate aerosols with unsafe levels of lead, cadmium, chromium, manganese, or nickel. Inhalation of these metals has been linked to lung, liver, immune, cardiovascular, brain damage, and cancers.

Other metals that can be in such vapors include

- aluminum
- barium
- boron
- copper
- iron
- silicon
- tin
- zinc

and the more metal parts in an e-cigarette the more heavy metals were found in the vapors produced. More frequently changed coils appear to give off more metals too. Some of these heavy metals have been found in higher concentrations than in tobacco smoke. Power is also an important factor with higher amounts of heavy metals as the voltage increased in the vaporizer. Conclusions included "Chromium, lead, and nickel are of particular concern as they are known carcinogens. Prolonged exposure to chromium from [e-cigs] aerosol could cause GI effects, nasal and lung cancers, respiratory irritation, and lung function impairment. Nickel inhalation can cause lung disease. Prolonged exposure to lead could produced cardiovascular effects and lung cancer…" (Scientific Reports, "Effects of model, method of collection, and topography on chemical elements and metals in the aerosol of tank-style electronic cigarettes" Monique Williams et all, Sept. 2019.)

There is widespread differences between various brands of e-cigs and how much toxic metals the vapor contains. One study by John Hopkins Bloomberg School of Public Health (Environmental Research, "E-cigarettes as a source of toxic and potentially carcinogenic metals" Catherine Ann Hess et al, Jan. 2017) found that the difference between the lowest and highest concentrations of different brands for various heavy metals were:

- chromium varied by 39 fold
- lead varied by 402 fold
- manganese varied by a factor of 240 fold
- nickel varied by 385 fold

These four metals are said to be of the most concern because they are all toxic when inhaled. Another study (Environmental Health Perspectives, "Metal concentrations in e-cigarette liquid and aerosol samples: the contribution of metallic coils" Pablo Olmedo et al, Feb. 2018) found that almost half of the aerosol samples had lead concentrations higher than health-based limits created by the EPA. And the other three metals noted above also had levels that approached or exceeded safe levels. They also found that arsenic was in some of the vapes and how it got there was a mystery.