Hallucinogens
Information for Health Professionals

Introduction
Hallucinogens are drugs that dramatically affect perception, emotions (mood), and mental processes (thought). They distort the senses and can cause hallucinations (seeing or hearing things that are not actually there); however, they usually cause lesser distortions of real objects and events. Since these disturbances of perception (visual hallucination) and behaviour cannot be classified as either sedative or stimulant effects, hallucinogens are sometimes called psychotomimetic.

Hallucinogens, such as peyote and psilocybin, have been used in religious or spiritual ceremonies for thousands of years, dating back as far as 1600 BCE (Before Common Era). Hallucinogens continue to be used by some groups such as the Native American Church, which uses peyote as part of its spiritual practices. Although there was some interest during the 1960s and 1970s in the use of hallucinogens as an aid to psychiatric treatment, presently there is no accepted medical use for hallucinogens.

Hallucinogens made synthetically include LSD, PCP and DMT. Some hallucinogens like MDA, MDMA (Ecstasy), and STP (DOM), have a chemical structure related to amphetamine. Hallucinogens derived from plants include mescaline from the peyote cactus, and psilocybin from “magic mushrooms”. Other plants containing hallucinogens include morning glory seeds, jimsonweed and nutmeg. Cannabis (marijuana) is not usually included in this group of drugs, but in very large dosage it can produce hallucinations.

There is considerable deception in the sale of hallucinogens. Users can never be certain what drug or how much of a particular drug they are taking. For example, magic mushrooms sold by dealers are frequently cheaper, grocery-store varieties of mushrooms laced with LSD or PCP, and harmful synthetic hallucinogens are sold as LSD. Hallucinogens are usually prepared in illegal “underground” labs specifically for the illicit drug market and can be contaminated with other very toxic substances.

Hallucinogens are usually taken orally, but are sometimes smoked, sniffed or injected.

How hallucinogens work
Most hallucinogens are also amphetamines that stimulate the sympathetic nervous system’s “fight or flight” response, causing pulse rate and blood pressure to rise in users, as well as trigger the onset of nausea or sweating. For more information on amphetamines, see “Amphetamines: Information for Health Professionals”.

The action of hallucinogens is complex and varied, with many hallucinogens having affinities for multiple neurotransmitter receptors. Hallucinogenic effects arise when hallucinogens activate the 5-HA_{2A} (serotonin) receptors, though not all serotonin receptor activators are hallucinogens. Hallucinogens

target serotonin receptors in the cortex of the brain, the region responsible for perception, cognition, and thought, and cause complex interactions between serotonin and glutamate systems to bring on the hallucinogenic effects. Effects range from ecstasy to terror, and may involve mild distortions to full hallucinations. Effects can include symptoms commonly observed in psychosis (thought disorder, split ego). Hallucinogens can also cause synesthesia, which is the crossover or mixing of the senses.

Short-term effects

The effect of any drug depends on a number of things such as the amount taken, how it is taken, user expectations and mental state, previous exposure to hallucinogens and other drugs, the physical and social setting, and other drugs being used.

The effect of taking a hallucinogen can be extremely variable, and a user's response can range from ecstasy to terror. During one episode, the user is likely to experience a variety of short-term effects. They include chills, tremor, weakness, dilated pupils, as well as a feeling of being weighed down or floating.

Hallucinations are most common at high dosages, whereas low dosages tend to produce changes in mood and lesser changes in perception. Thinking and concentration may become difficult, and short-term memory may be impaired. Hearing, smell, and vision may be intensified or merged, and the user's sense of time and space may also be impacted. Users may also experience depersonalization; feeling like they are outside themselves observing what is happening, or even feeling like they are off the earth, on a so-called "trip". Some users describe a sense of mind expansion or insight, while others report aesthetic experiences or even mystical or spiritual sensations. These experiences may be pleasant for some users; at other times, the same users may find the effects of hallucinogen use very unpleasant, and these effects may cause considerable distress and even panic. The resulting "bad trip" may in part be due to the great variation in the content of illicit drugs, but can also occur when the same dose of pure drug is taken.

"Trips" are often taken in the company of experienced users who can help deal with any unpleasant reactions that may occur. However, for some users "bad trips" can result in prolonged serious depression, anxiety, and even psychotic reactions.

Long-term effects

Long-term effects of hallucinogen use are usually more mental than physical. Some of the effects associated include depression, anxiety, and flashbacks. "Flashbacks" are recurrences of the previous drug experience without taking the drug again; these can occur for days, weeks, or even months after use. Flashbacks can be pleasant or very disturbing. While flashbacks usually do not continue for longer than six months, users often experience an unusual sensation.

Psychosis and paranoia have also been associated to the use of hallucinogens but is thought to occur in people with latent or underlying mental health issues.

LSD ("lysergic acid diethylamide", "acid", "blotter")

LSD is a very potent hallucinogen. It can be made from lysergic acid, which is found in ergot, a fungus that grows on rye and other grains. Most street LSD, however, is prepared synthetically in illicit labs. Pure LSD is a white, odorless powder. The usual dose or "hit" of LSD is in the range of 50 to 100 micrograms, but can be as high as 700 micrograms. For reference, there are 400,000 micrograms in a typical 400 milligram ibuprofen pill. Thus, LSD is the most potent of hallucinogens. Since a single hit of LSD is almost invisible, it is mixed with other substances such as sugar and sold in capsules, tablets or liquid. It can also be dissolved in liquid and spotted on gelatin sheets or blotting paper, hence the street names "window pane" and "blotter".

LSD is usually taken orally, but can be inhaled or injected. As with any injection, use of needles that are not sterile can result in infections, and sharing needles with others can spread hepatitis and HIV/AIDS.

LSD is the most commonly known hallucinogen. The mentioned description of the general effects of hallucinogens applies particularly to LSD. In discussing the other hallucinogens, LSD will serve as the prototype.

The effects of LSD usually begin within an hour and last up to 12 hours. Physical effects appear first, and may include numbness, muscle weakness and trembling, dilated pupils, impaired motor skills and co-ordination, nausea, high blood pressure, increased heart rate, and (rarely) seizures. In addition to acute effects on perception, thought, and mood, chronic LSD use may result in prolonged depression and anxiety.

No deaths are known to have been caused by the direct effects of LSD in humans; however, suicides and accidental deaths related to LSD use have been reported.

PCP ("phencyclidine", " angel dust", "horse tranquilizer", "wack")

PCP was first used as an anesthetic for surgery in humans, then as an animal anesthetic and tranquilizer. It is no longer used for those purposes and is now produced only in illicit labs. Despite the fact that it is one of the most dangerous and unpredictable hallucinogens, it continues to be a frequently encountered street drug. The incidence of use is unknown, as it is usually included with other hallucinogens in drug use surveys.

Pure PCP is a white powder. It is sold on the street as a powder, liquid, capsule or tablet and is often passed off as LSD, THC, mescaline, or other drugs. PCP is usually mixed with tobacco, marijuana or dried parsley, and the mixture is then smoked. PCP may also be sniffed, swallowed or injected. A dose of 1 mg to 5 mg is enough to cause a high, though street samples have contained 1.3 mg to 81 mg.

The effects of PCP can vary greatly even when comparable doses are taken. In addition, the strength of street samples is extremely variable, so the amount taken can also vary greatly. When it is presumed to be some other drug with relatively mild effects, such as mescaline or peyote, the stronger and more unpredictable effects of PCP can be distressing for the user. The short-term effects of low dosages of

PCP appear soon after taking a single dose and disappear within a few hours or days. The effects of high doses, however, have lasted from 10 days to two weeks.

The physical effects of low doses of PCP (5 mg or less) include rapid breathing, increased blood pressure and heart rate, a marked rise in temperature, and numbness of the arms and legs. Doses of 10 mg or more may cause a rapid drop in blood pressure, heart rate, and respiration, along with nausea, vomiting, blurred vision, dizziness, and decreased awareness of pain. Larger doses can cause convulsions, coma, and death. Psychological effects include impairment of the user's ability to concentrate, think logically and speak. Marked changes in perception, thought, and mood similar to those produced by LSD can occur. Many users experience euphoria; others feel threatened and may behave violently towards themselves or others because of fear, anxiety, or panic.

The effects of higher doses include delusions, hallucinations (mainly auditory), and a sensation of distance from one's environment. Severe psychological disorganization and acute toxic psychosis can result. Deaths linked to the psychological effects have included accidental drowning, suicides, homicides, and car crashes. The long-term effects of using PCP are not well documented, as it is not often used on a regular basis. Similar to other hallucinogens, flashbacks can occur and can last months to years.

MDA (methylenedioxyamphetamine)

MDA is classified as both a hallucinogen and an amphetamine. The structure of MDA is similar to both mescaline and amphetamine. As a brown or white powder, MDA is sold loose, in capsules, or as an amber liquid. The common dose is 100 mg, which is usually swallowed. Other drugs such as PCP are frequently sold as MDA.

The effects of MDA occur in 30 to 60 minutes and last about eight hours. Users report a sense of well-being along with heightened tactile sensations and emotions. Higher doses produce effects similar to those of amphetamines and include dilated pupils, high blood pressure, and dry nose and throat. MDA overdoses can also cause death.

MDMA (3,4-methylenedioxymethamphetamine, "molly", "M", "ecstasy,", "X", "XTC")

MDMA is classified as both a hallucinogen and an amphetamine. MDMA is similar in structure to MDA and is sold as white or off-white powder. It is usually taken orally in doses of 75 mg to 100 mg. MDA and MDMA have both stimulant and psychedelic effects.

The effects of MDMA are also similar to MDA, but are somewhat milder and of shorter duration. Long-term use or heavy use of MDMA can elicit negative effects; including sleeping difficulties, high blood pressure, jaundice, liver problems, panic attacks, seizures, as well as memory and attention deficits.

DOM (2,5-dimethoxy-4-methyl-amphetamine, "STP")

DOM is classified as both a hallucinogen and an amphetamine. DOM is similar to MDA bur more potent (usual doses range from 3 to 10 mg) and longer acting (16 to 24 hours). However, since it has a reputation for creating "bad trips", DOM is rarely encountered on the street anymore.

PMA (paramethoxyamphetamine, "death", "Dr. Death") & PMMA (paramethoxymethamphetamine)

PMA and PMMA are classified as both hallucinogens and amphetamines. Although rare, PMA and PMMA are two of the most dangerous hallucinogens. Sold as beige, white or pink powder, these drugs are often misrepresented as MDA. However, at high doses MDA, PMA and PMMA are highly toxic.

The hallucinogenic effects of PMA and PMMA are similar to those of LSD; physical effects of PMA and PMMA resemble MDMA and includes racing pulse, high blood pressure, increased and labored breathing, high fever, erratic eye movements, muscle spasm, and vomiting. At high doses, convulsions, coma and death can result. Between 2011 and 2012, there were 27 deaths in Alberta and British Columbia related to ecstasy containing PMMA.

Mescaline or Peyote (3,4,5-trimethoxy-phenethylamine, "mesc", "cactus", "buttons")

Mescaline is prepared from the Mexican peyote cactus, the San Pedro and Peruvian Torch cacti of South America, or synthesized chemically. Mescaline is usually taken orally in a capsule or tea, but can also be inhaled by smoking ground peyote "buttons" or (more rarely) injected. The usual dose is 300 to 500 mg. much of the so-called mescaline sold on the street actually contains PCP, LSD or other substances.

Physical effects of mescaline ingestion include dilated pupils, fever, nausea and vomiting. High doses can cause headache, dry skin, low blood pressure, and slowing of heart rate and breathing. Psychological effects similar to those of other hallucinogens appear slowly, and last for 8 to 12 hours.

Psilocybin ("magic mushrooms", "shrooms", "caps")

Psilocybin and the related chemical psilocin are the active ingredients in several species of mushrooms and other fungi that grow throughout Canada. Most belong to the genus *Psilocybe*. Psilocybin is chemically related to both LSD and DMT.

Psilocybin is sold as mushrooms or in capsules containing powder of various colours. The common dosage ranges from 5 mg to 60 mg taken orally. When ingested orally, psilocybin usually takes 20-30 minutes to take effect, but can take up to 2 hours. A "trip" can last 3-8 hours depending on strength, potency, and dose taken.

Low doses produce mild psychedelic effects; larger doses cause LSD-like effects and users often report mystical or religious experiences. Physical effects can include dizziness, light-headedness, abdominal discomfort, numbness of the tongue and mouth, nausea, anxiety and shivering.

DMT (dimethyltryptamine)

A chemical resembling psilocin, DMT occurs naturally in certain plants. Most street DMT, however, is prepared synthetically in illicit labs. Marijuana or parsley are often soaked in a solution of DMT, then dried and smoked.

The effects of DMT occur rapidly, unlike those of other hallucinogens that usually last for 30 to 60 minutes—hence the street name "businessman's lunch". Anxiety reactions and panic states tend to be quite common, possibly because of the rapid onset of the drugs potent effects.

Other hallucinogens (morning glory seeds, nutmeg, jimsonweed)

A variety of other plants contain hallucinogens. Morning glory seeds contain lysergic acid amide, which is chemically related to LSD, but less potent. Effects similar to those of LSD begin 30 to 90 minutes after 100 or more of the seeds are chewed. However, most seeds are now coated with insecticides and/or herbicides that can cause considerable discomfort if ingested.

Nutmeg powder is a common household spice that is eaten and sometimes "snorted" for its psychedelic effects. Low doses around 5 grams can produce mild euphoria, light-headedness, and stimulation. Doses from 5 to 30 grams can cause rapid heartbeat, agitation, vomiting and hallucinations. Recovery is slow and often involves an unpleasant hangover. Although readily available, nutmeg is generally used only when other hallucinogens are not available.

Jimsonweed (*Datura stramonium*) and deadly nightshade (*Atropa belladonna*) both contain atropine and other belladonna alkaloids. A variety of prescription drugs derived from this family of plants are used to decrease stomach motility and secretions, dilate the pupils, relax smooth muscles and treat the tremors associated with Parkinson's Disease. Eating the leaves or berries of these plants causes marked dryness of the mouth, dilated pupils, hot and dry skin, blurred vision, raised body temperature, rapid heartbeat, constipation and difficulty urinating. Larger doses produce intense stimulation of the nervous system including hallucinations, disorientation, confusion, agitation, and sometimes convulsions.

Hallucinogens and pregnancy

Little is known about the effects of using hallucinogens during pregnancy. Regular LSD use during pregnancy is associated with spontaneous abortions or fetal abnormalities; however, in most cases, mothers have also taken other drugs that could have contributed to these effects. Studies suggesting that LSD use causes chromosome damage have yet to be confirmed. Other hallucinogens like MDMA, appear to have adverse effects on infant motor functioning, memory, sleep, and brain integrity when used in pregnancy.

Tolerance and dependence

Tolerance to hallucinogens is not well understood. Tolerance does not develop with repeated use of more hallucinogens; however, after daily use for as little as three or four days, no psychoactive effects will be experienced. The effects return if no use occurs for several days. This is not a true

pharmacological tolerance, as it cannot be overcome with larger doses of the drug (although LSD exhibits cross-tolerance to other hallucinogenic drugs).

PCP may be an exception, since regular users often increase their intake in order to maintain the "high". Hallucinogens do not appear to cause physical dependence, as withdrawal reactions have not been observed even after long-term use. However, some regular users of hallucinogens become psychologically dependent on these drugs, and the desire to keep taking them becomes a compulsion.

Withdrawal and treatment

With most hallucinogens, physical withdrawal symptoms are not experienced when a user stops taking the drug; however, psychological withdrawal can occur. Treatments like Cognitive Behavioural Therapy (CBT) and support groups are common. For users experiencing psychosis or mental health issues, medications may be prescribed.

For those who are experiencing adverse effects after taking the drug, it is recommended that they be kept as calm as possible and taken to the hospital to receive treatment and observation.

Who uses hallucinogens?

Around 12% of Canadians have used hallucinogens in their lifetime. Although past-year use of hallucinogens among the general population is low (1.2%), there has been a 0.6% increase from 2013 to 2015, according to national survey findings.

According to the 2015 Canadian Tobacco Alcohol and Drugs Survey (CTADS), the prevalence of ecstasy use among Canadian youth aged 15-24 has risen 1.5% and 0.4% among the general population since 2013. Past year use is around 2.4% in Canadian grade 7 to 12 students and 4% among grade 10-12 students.

Hallucinogens and the law

With a few exceptions, all of the hallucinogens are classified as controlled substances in Canada's Controlled Drugs and Substances Act. Morning glory seeds, nutmeg and jimsonweed are not subject to any legal restrictions in Canada.

PCP, MDA, MDMA, DOM, and PMA are all classified by Canada's *Controlled Drugs and Substances Act* as a Schedule I drug. If caught in possession of a Schedule I drug, first time offenders may face a fine of up to $1,000 and/or imprisonment for up to six months. For subsequent offences, the penalty is a fine of up to $2,000 and/or imprisonment for up to one year. For more serious indictable offences, the penalty is imprisonment for up to 7 years. Trafficking, possession for the purpose of trafficking, production, and importing and exporting these drugs are serious offences and are punishable on summary conviction from one year up to life imprisonment.

LSD, mescaline/peyote, psilocybin, and DMT are all classified as Schedule III drugs. A prescription or license, such as a medical marijuana card, is needed to possess these drugs, otherwise a minimum $1000 fine and/or 6-month stay in prison may occur. For subsequent offences, the penalty is a fine of up to $2,000 and/or imprisonment for up to one year, with indictable offences punishable by a maximum of 3 years imprisonment. As a summary offence, possessing, trafficking, exporting, or producing these drugs are punishable to a maximum of 18 months imprisonment. For indictable offences, this increases to a maximum 10 years imprisonment.

References

Baumann, M. H., & Rothman, R. B. (2009). Neural and cardiac toxicities associated with 3, 4-methylenedioxymethamphetamine (MDMA). *International Review of Neurobiology, 88*, 257-296. doi: 10.1016/S0074-7742(09)88010-0

Canadian Centre on Substance Use and Addiction. (2017). *Canadian drug summary: ecstasy or molly (MDMA)*. Retrieved from http://www.ccsa.ca/Resource%20Library/CCSA-Canadian-Drug-Summary-MDMA-2017-en.pdf

Carbonaro, T. M., & Gatch, M. B. (2016). Neuropharmacology of n,n-dimethyltryptamine. *Brain Research Bulletin, 126*(Pt. 1), 74-88. doi: 10.1016/j.brainresbull.2016.04.016

Centre for Addiction and Mental Health. (2009). *Hallucinogens*. Retrieved from https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/hallucinogens

Centre for Addiction and Mental Health. (2010). *LSD*. Retrieved from https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/lsd

Controlled Drugs and Substances Act, SC 1996, c 19. Retrieved from http://laws-lois.justice.gc.ca/eng/acts/C-38.8

Global Information Network About Drugs. (n.d.). *Mescaline*. Retrieved from http://www.ginad.org/en/drugs/drugs/292/mescaline

Global Information Network About Drugs. (n.d.). *Psilocybin*. Retrieved from http://www.ginad.org/en/drugs/drugs/309/psilocybin

Government of Canada. (2018). *PCP*. Retrieved from https://www.canada.ca/en/health-canada/services/substance-abuse/controlled-illegal-drugs/pcp.html

Halberstadt, A. L. (2017). Hallucinogenic Drugs: A New Study Answers Old Questions about LSD. *Current Biology*, *27*(4), R156–R158. doi: 10.1016/j.cub.2016.12.058

Health Canada. (2015). *Canadian Student Tobacco, Alcohol and Drugs Survey: Supplementary Tables*. Ottawa, Ont.: Author.

Lee, H. M. & Roth, B. L. (2012). Hallucinogen actions on human brain revealed. *PNAS, 109*(6), 1820-1821. doi: 10.1073/pnas.1121358109

Lobez-Gimenez, J. F., & Gonzalex-Maeso, J. (2018). Halucinogens and Serotonin 5-HT2A Receptor-Mediated Signaling Pathways. In A. L. Halberstadt, F. X. Vollenweider, & D. E. Nichols (Eds.), *Behavioral Neurobiology of Psychedelic Drugs* (pp. 45–74). Berlin, Germany: Springer.

National Institute on Drug Abuse for Teachers. (2018). *LSD—Mechanism of Action*. Retrieved from https://teens.drugabuse.gov/teachers/mind-over-matter/teachers-guide/hallucinogens/mechanism-action

Nicol, J. J. E., Yarema, M. C., Jones, G. R., Martz, W., Purssell, R. A., MacDonald, J. C., …Buxton, J. A. (2013). Deaths from exposure to paramethoxymethamphetamine in Alberta and British Columbia, Canada: a case series. *CMAJ Open, 3*(1), 83-90. doi: 10.9778/cmajo.20140070

Parrot, A. C., Moore, D. G., Turner, J. J. D., Goodwin, J., Min, M. O., & Singer, L. T. (2014). MDMA and heightened cortisol: A neurohormonal perspective on the pregnancy outcomes of mothers used "ecstasy' during pregnancy. *Human Psychopharmacology, 29*(1), 1-7. doi: 10.1002/hup.2342

Passie, T., Halpern, J. H., Stichtenoth, D. O., Emrich, H. M., & Hintzen, A. (2008). The pharmacology of lysergic acid diethylamide: A review. *CNS Neuroscience & Therapeutics, 14*(4), 295-314. doi: 10.1111/j.1755-5949.2008.00059.x

Poison and Drug Information Service (PADIS). (2017). *Alcohol and drug problems: Common questions about PMA and PMMA*. Retrieved from https://myhealth.alberta.ca/Alberta/Pages/pma-and-pmma.aspx

Rahman, N. A. A., Fazilah, A., & Effarizah, M. E. (2015). Toxicity of nutmeg (myristicin): A review. *International Journal of Advanced Science Engineering Information Technology, 5*(3), 61-64. Retrieved from http://www.insightsociety.org/ojaseit/index.php/ijaseit/article/download/518/pdf_20

Spina, S. P., & Taddei, A. (2007). Teenagers with jimson weed (Datura stramonium) poisoning. *Canadian Journal of Emergency Medicine, 9*(6), 467-469. doi: 10.1017/S1481803500015530

Statistics Canada. (2016). *Canadian Tobacco Alcohol and Drugs (CTADS): 2015 summary*. Ottawa, ON: Author. Retrieved from https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2015-summary.html

Vollenweider, F. X., & Kometer, M. (2010). The neurobiology of psychedelic drugs: implications for the treatment of mood disorders. *Nature Reviews Neuroscience*, *11*, 642. doi: 10.1038/nrn2884

For more information about this document, contact Knowledge Exchange, Provincial Addiction and Mental Health, Alberta Health Services at researchpartnership@ahs.ca.

Updated November 13, 2018