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General
Drugs
of Abuse

LSD: New Information and Resources for Drug- Screening Professionals

Answers for life.

SIEMENS

Syva has been a leading developer and manufacturer of drugs-of-abuse tests for more than 30 years.

Now part of Siemens Healthcare Diagnostics, Syva® boasts a long and successful track record in drugs-of-abuse testing, and leads the industry in the production of enzyme immunoassays. In addition to drugs-of-abuse assays, Syva has been a key player in the development and manufacture of therapeutic drug monitoring assays.

Syva products are sold in more than 45 countries worldwide.

Screening for abused drugs provides clear payoffs in terms of productivity, health, and deterrence. That's why more than ninety percent of employers with over 5,000 employees—and virtually all criminal justice courts—now maintain some type of testing program.¹

Today, the question for employers and criminal justice administrators is not whether to test. It's who to test, when to test, how to test, and what to test for.

With recent breakthroughs in convenient commercial testing for LSD, those who manage drug-screening programs now face a new set of questions: Who's using LSD today? What's the prevalence? What are the dangers? Isn't LSD unstable and still hard to detect and confirm? Should we add LSD to the panel?

Because a simple and automated LSD test was not available until 1996, many screening professionals—though aware of the possibility of LSD use in their test populations—never seriously considered adding LSD to their panels. With the new monoclonal antibody based EMIT® II LSD Assay from Syva, the questions related to LSD use and screening are suddenly more relevant than ever. This booklet provides the context and content necessary to answer these important questions.

LSD's Discovery

Ergot, the grain fungus that caused deadly epidemics during the Middle Ages, was adapted for medical use by midwives as early as the 16th century. Chemists refined pure ergot extracts in the early 20th century, and in 1934 isolated the structure common to all ergot alkaloids: lysergic acid.²

In the late 1930s, Swiss chemist Albert Hoffman synthesized a whole family of lysergic acid derivatives. The twenty-fifth derivative in this series was d-lysergic acid diethylamide.³ In 1943, Hoffman accidentally ingested trace amounts of the substance and thus became the first to recognize the unparalleled mind-altering effects of LSD—now known to be 100 to 1000 times more powerful than natural hallucinogenic substances such as peyote (from cactus) and psilocybin (from “magic mushrooms”).⁴

Early History of Use

In the '50s and early '60s, commercially produced LSD was tested variously as an adjunct to psychotherapy; a cure for alcoholism; and a tool to probe the pathogenesis of schizophrenia, psychosis, and depression.^{4,5}

In the '60s, many psychiatrists and psychologists started self-experimenting with the drug and exploring its potential as a biochemical aid for personal growth, self-understanding, and enhanced creativity. Despite the government ban on hallucinogenic drugs in 1965, use of psychedelic drugs spread, especially within the high school and college age population.^{2,6,7}

By the late '70s and '80s, however, LSD consumption dipped sharply. This was undoubtedly due to the new wealth of personal experience with the drug, and the growing body of publicity about the dangers of LSD—including accounts of “bad trips” involving suicides and psychoses, as well as some (now discredited) reports of LSD-induced chromosomal damage.^{4,6,8}

Recent Trends

In recent years, there has been a troubling resurgence in LSD use. The increase among adolescent populations seen during the early '90s—today's college and entry-level worker populations—is especially disturbing. This generation is too young to recall the early evidence of LSD's highly unpredictable effects.⁹ Also, first-time users today take LSD “hits” in doses less likely to produce bad reactions—generally at about a fifth of the typical doses of 100–200 µg seen in the '60s. This, of course, merely increases the likelihood of repeat use with higher total dosages necessary to overcome developing tolerance.^{4,8} Perception of danger by users, so critical in anti-cocaine efforts, is woefully lacking with LSD today.¹⁰

Other data,⁴ and a growing body of news reports point to a sad re-enactment of the painful outcomes of the '60s and '70s: the bad trips; suicides; bizarre and sometimes violent behavior; flashbacks, and the possibility of long-term psychologic impairment.^{4,13}

Among the facts on current usage trends:

- Emergency room visits related to LSD rose considerably at the beginning of the decade and have remained at about 4,000 per year¹⁴ (a rate similar to that seen for PCP15).
- Reports of LSD-related violent behavior, including suicide, homicide, and accidental death, have also increased.⁴
- LSD use is greatest among Caucasian males.^{4,13,14}
- Over half of today's high school seniors say it would be “easy” or “fairly easy” to get LSD.¹²

The Effects of LSD: Potent, Unpredictable

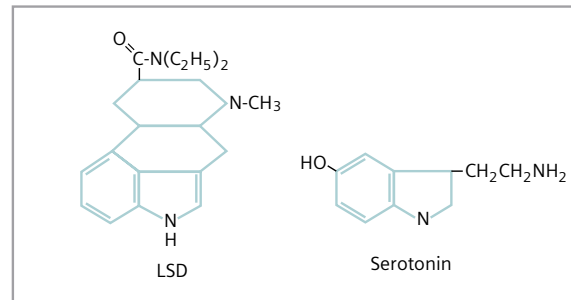
Almost always taken orally, LSD can produce profound changes in perception, mood, thinking, and self-image at doses as low as 25 µg. Effects typically begin about 30–60 minutes after ingestion (the sympathomimetic effects start earliest) and last 10–12 hours. The physical effects, though less dramatic than the psychological effects, may include dilated pupils; elevated body temperature; increased heart rate and blood pressure; sweating; loss of appetite; sleeplessness; dry mouth; and tremors.^{4,16,17}

The mental effects of an LSD “trip” can be intense and prolonged. The alterations in perceptions, sensations, and feelings are highly unpredictable, and depend not only on the dose, but also on the user’s personality, mood, expectations, and surroundings. Even the same individual repeating an identical LSD dose, in an identical setting, may react unpredictably. Generally, the psychological impact of LSD involves a distorted sense of the passage of time, intensified perception of colors and sound, and vivid visual hallucinations (eg, geometric or kaleidoscopic patterns, swirling lights, heavily “thematic” landscapes). A profound, and sometimes unsettling change in the sense of core self is not uncommon, especially during the peak hours of the drug experience.^{4,16-18}

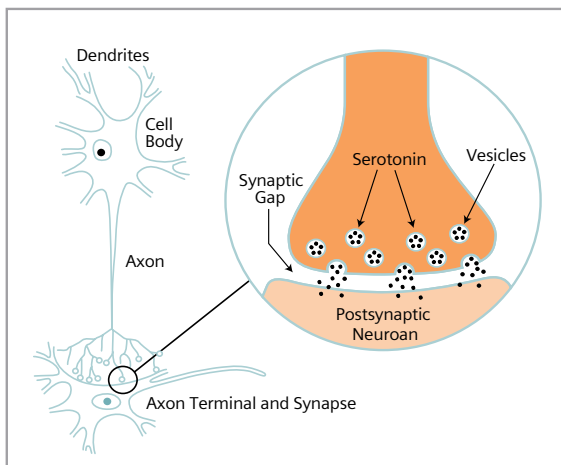
Some LSD users maintain a pleasant or euphoric mood throughout the entire drug-shaped period. However, many others will pass through deep states of panic, hyperanxiety, paranoia, disorientation, or impaired judgement. Many individuals report a sense of losing control or a fear of insanity or death. Those experiencing such “bad trips” often report seeing terrifying images, such as crawling bugs on the skin, Satan’s face, or grotesque masks on other people. Severe depression is common in the 24-hour period after LSD ingestion.¹⁶⁻¹⁸

How Hallucinogens Act in the Brain

All three major hallucinogens—LSD, mescaline, and psilocybin—produce characteristic psychic, somatic, and sensory-perceptual effects and display classic cross-tolerance (eg, diminished hallucinatory response to mescaline if LSD had been taken the previous day).¹⁹ The common denominator among these classic hallucinogens is most likely one or more shared serotonin receptor binding sites in the brain. Along with nor-epinephrine and dopamine, serotonin (5-hydroxytryptamine, or 5-HT) is one of the most ubiquitous chemical neurotransmitters facilitating communication between brain cells. LSD shares structural similarities with serotonin and is known to trigger dramatic changes in animal serotonin levels.¹⁹⁻²¹ Recently, in fact, use of selective serotonin receptor reuptake inhibitors (eg, fluoxetine hydrochloride) has been reported to exacerbate LSD flashbacks.²²



Thus, it now seems clear that LSD binds to the serotonin receptors in the brain. Researchers are only now beginning to understand how these serotonin receptors create the intricate web of cell-to-cell communication that shapes all perception, personality, and behavior—a web that abruptly falters under the influence of LSD.



LSD is thought to act as serotonin neuroreceptors of the “receiving” brain cells¹⁹

LSD on the Street ^{4,8,14,16,17}

- LSD is often called “acid,” and taking LSD is “dropping acid.”
- LSD is not easy to manufacture, but a handful of labs can supply the whole country (just one gram of LSD equals 10,000 individual dosage units); most labs are thought to be in the West and Northwest.
- The active dose of LSD is so small that it needs to be diffused in a carrier of some sort before distribution. In most cases, LSD is mixed in alcohol and then soaked or sprayed onto absorbent blotter paper; each blotter sheet is perforated into hundreds of small 6 mm squares, each of which represents a single dose or “hit” of LSD; blotter paper is often printed with identifying designs.
- On rare occasions, LSD is formulated into tiny gelatin squares (“windowpane” or “microdot”), tablets, sugar cubes, or liquid form.
- Always taken orally, standard doses of LSD today average 20–80 µg per hit, compared to 100–200 µg in the ‘60s and ‘70s. Experienced users may take multiple hits.

- Cost is generally around \$4–\$5 per hit (about the same as a couple of marijuana cigarettes or a sixpack of beer).
- Frequent users of LSD may be called “acid heads” or “acid freaks.”

The Dangers of LSD

While LSD could be called a safe drug in the strict pharmacological sense (only two deaths due to LSD toxicity have been reported), the acute and chronic psychological sequelae pose very real dangers. The negative physical and mental health outcomes, even from “simple one-time experimentation” with LSD, can be extreme.

Acute Risks

The major short-term dangers of LSD intoxication include panic-induced self-aggressive acts or depression— including suicide attempts. Accidents, homicides, and suicides have all been directly associated with the use of LSD and other psychotropic drugs, and this remains an understudied and under-reported trend.^{7,16}

Clinicians working the ER often describe the panic reactions of patients with suspected LSD toxicity with words such as “bizarre,” “excited,” “violent,” “delusional,” or “hallucinating.” Distinguishing such clinical findings from stimulant overdose or non-drug-related psychosis in the ER setting is one indication for laboratory testing for LSD intoxication.²³

In most cases of LSD panic reaction, the user can be “talked down” by a knowledgeable and sympathetic care giver in a quiet environment. In some of the most agitated cases, however, benzodiazepines, such as diazepam, or antipsychotics, such as haloperidol, must be given intramuscularly to control anxiety and prevent impulsive actions. Most talkdowns require 8–12 hours, but a small percentage of patients require overnight observation.^{4,6,24}

Lingering Effects

In the longer term, as many as half of those who have tried LSD will report experiencing “flashbacks,” which are sudden visual reminders of the hallucinatory experience most often involving fast-moving lights or colored patterns. Sometimes referred to as post-hallucinogen perceptual disorder, flashbacks are most common in frequent users, and can appear many years after the user’s last LSD experience. In some individuals, flashbacks are triggered by alcohol or marijuana, or emergence into a dark environment.^{4,18}

Long-lasting psychoses, schizophrenia, and depression are other suspected chronic adverse effects of LSD use.^{4,7,16,18} Most individuals who progress to these rare but serious psychiatric problems are probably predisposed due to an underlying genetic or personal history of mental illness (eg, schizophrenic susceptibility, serious depressive disease, psychosis).^{4,6,7,18} Of course, trying to identify and warn such vulnerable individuals is practically impossible.

In recognition of LSD’s broad dangers and increasing usage, federal penalties for the sale and possession of LSD have become significantly stiffer in recent years. However, only widespread education and increased publicity on the dangers of LSD use—especially education and screening programs aimed at deterrence—will help reverse the recent trend of increased LSD use.

Is LSD a Problem in Your Population?

You may be surprised. The most recent home- and school-based surveys on drug abuse show that LSD use is growing nationwide. Acceptance of casual LSD use among teens is also growing due, in part, to the low price at which it is available. Unfortunately, because LSD assays suitable for high-volume screening are so new, data on prevalence, and associated medical and mental health outcomes are scarce. In the current information vacuum, those in charge of drug screening programs must look

locally to gauge LSD usage patterns. In addition to their own screening surveys, such sources might include local newspaper articles; school drug prevention program surveys; county criminal justice arrest statistics; and data from administrators at drug crisis centers, mental health hotlines, and emergency departments.

Screening for LSD

How Is It Done?

The main commercial assays for LSD are radioimmunoassay^{23,25} and enzyme immunoassay.²⁶ The EMIT II LSD immunoassay is particularly simple and inexpensive, providing qualitative or semi-quantitative results similar to those seen with other EMIT screening tests.

How Is a Positive Result Confirmed?

Positive results can be confirmed by using a more specific chemical method on a second portion of the original sample. Gas chromatography/mass spectrometry (GC/MS) is the most common confirmation method. High performance liquid chromatography (HPLC) and other specialized techniques such as thin layer chromatography and fluorometry are often used in research.

When Is Screening for LSD Appropriate?

Until recently, testing for LSD was largely limited to emergency departments, forensic labs, and toxicology research settings. The new ability to add a sensitive and specific LSD enzyme immunoassay to existing drug panels now allows medical officers and administrators to expand and strengthen the impact of their screening programs in a variety of industrial, criminal justice, military, and medical settings.

Why Add LSD to the Panel?

As with all drug screens, the purpose of the LSD screen is to deter use, boost employee performance and/or treatment compliance, increase workplace and societal safety, and facilitate treatment of

individuals in counseling programs. Such screening programs have also been shown to be cost beneficial in several settings—the implementation costs being less than the costs related to the incrementally increased drug use associated with non-screening environments.²⁷ LSD use has been linked to adverse and potentially costly outcomes. Both prevalence of use and ease of acquisition have increased in recent years. Adding LSD to the standard screening panel will strengthen overall drug abuse prevention goals by plugging a gap in most screening efforts.

How Long Does LSD Stay in the Urine?

Although the plasma half-life of LSD is 3 to 5 hours, LSD and its metabolites can be detected in urine for several days following ingestion.²⁸

Isn't LSD Unstable and Difficult to Confirm?

No. With routine laboratory attention to temperature and handling of urine samples, LSD has been shown to remain stable for long periods. Appropriately-frozen urine specimens containing LSD have remained stable for years.

What Are Typical Urine Levels?

A typical range of LSD urine concentration 24 hours after ingestion of 200–400 µg LSD is 0.1–5.5 ng/mL. However, controlled studies have shown that concentrations of LSD and metabolites of 10–50 ng/mL are not uncommon. In the 34–120 hour period following ingestion, concentrations of LSD plus its metabolites typically range from 0.2 to 2.8 ng/mL.²⁸

Can Today's Tests Detect the Low Concentration of LSD Capable of Producing an Acid Trip?

It is true that analytic sensitivity is critical in LSD screening tests, because LSD is neurologically active even at vanishingly low concentrations. This is precisely why the LSD test was the last of the major drug screening tests to be refined and brought to market. Today's new monoclonal-antibody based LSD screening test can detect LSD at a cut-off of 0.5 ng/mL—the concentration chosen by U.S. Department of Defense clinicians and scientists as the cut-off between negative and positive.²⁹

Do LSD Tests Cross-React with Other Hallucinogens or Psychoactive Drugs?

Test specificities will vary by manufacturer. In general, though, screening assays should not give positive results for samples containing compounds structurally unrelated to LSD—including amphetamines, morphine, phencyclidine, psilocybin, serotonin, and L-tryptophan.

Resources for More Information on LSD and the Effectiveness of Drug Screening

Substance Abuse and Mental Health Services Administration

National Clearinghouse for Alcohol and Drug Information

P.O. Box 2345
Rockville, MD 20847-2345
+1 (800) 729-6686

Office of National Drug Control Policy

Drug Policy Information Clearinghouse
National Criminal Justice Reference Service
P.O. Box 6000
Rockville, MD 20849-6000
+1 (800) 666-3332

Institute for a Drug-Free Workplace

10701 Parkridge Boulevard, Suite 300
Reston, VA 20191
1 (703) 391-7222

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