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SUBSTANCE ABUSE AND TOXICOLOGICAL TESTS

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OBJECTIVES

After completing this chapter, the reader should be able to

- List the general analytical techniques used in substance abuse and toxicological screening and discuss their limitations
- Compare the uses of preliminary and confirmatory urine drug tests
- Discuss the considerations in interpreting a positive and negative drug screen result
- Discuss why interfering substances can cause false-negative and false-positive results of screening tests
- Recognize the uses of serum drug concentrations in the evaluation and treatment of a patient who has a suspected poisoning or overdose
- Describe how the pharmacokinetics of a drug in overdose may affect the interpretation of serum concentrations
- Discuss how toxicologic analyses may be helpful in medicolegal situations, postmortem applications, athletic competition, and prescription drug abuse

When substance abuse, poisoning, or overdose is suspected, the testing of biological specimens is crucial for characterizing usage or exposure, monitoring therapy or abstinence, or aiding in diagnosis or treatment. Millions of Americans are potentially subject to these types of tests. According to the 2014 National Survey on Drug Use and Health, 27 million Americans aged 12 years and older (10.2% of the population) reported using an illicit drug in the past month and 44.2 million (16.7%) reported illicit drug use during the past year (**Table 5-1**).¹ Poison control centers document approximately 2 million unintentional and intentional poison exposures each year with one half occurring in children under six years of age, approximately 90% of cases occurring in homes, and two thirds managed onsite in a nonhealth-care facility (**Table 5-2**).²

Illicit drug use during 2014 has been estimated to involve 17.4 million part-time and full-time workers aged 18 years and older with another 12 million claiming heavy alcohol use (five or more drinks per occasion on five or more days).¹ Based on 9.1 million urine drug screens performed by a nationwide laboratory service in 2014 for the combined U.S. workforce, 3.9% had positive test results (**Table 5-3**).³ In 2014, 22.5 million Americans (8.5% of the population) needed treatment for a problem with the use of alcohol or illicit drugs.¹

TABLE 5-1. Americans Aged 12 Years or Older Reporting Use of Illicit Drugs During 2014¹

SUBSTANCE	PERCENTAGE OF THE TOTAL POPULATION	
	PAST YEAR (%)	PAST MONTH (%)
Any illicit drug	16.7	10.2
Marijuana and hashish	13.2	8.4
Cocaine	1.7	0.6
Crack cocaine	0.3	0.1
Heroin	0.3	0.2
Hallucinogens	1.6	0.4
Lysergic acid diethylamide (LSD)	0.5	0.1
3,4-methylenedioxy-N- methamphetamine (MDMA, Ecstasy)	0.9	0.2
Inhalants	0.6	0.2
Any illicit drug other than marijuana	7.4	3.3
Nonmedical use of any		
Psychotherapeutic drug	5.6	2.5
Pain reliever	3.9	1.6
Tranquilizer	2.0	0.7
Stimulant	1.4	0.6
Sedative	0.3	0.1

TABLE 5-2. Ranking of Twelve Most Frequent Poison Exposure Categories Reported to U.S. Poison Control Centers During 2014^{a,b}

ALL EXPOSURES	CHILDREN (UNDER SIX YEARS)	ADULTS (OVER 19 YEARS)
Analgesics	Cosmetics, personal care products	Analgesics
Cosmetics, personal care products	Cleaning substances	Sedatives, antipsychotics
Cleaning substances	Analgesics	Antidepressant drugs
Sedatives, antipsychotics	Foreign bodies	Cardiovascular drugs
Antidepressant drugs	Topical drugs	Cleaning substances
Antihistamines	Vitamins	Alcohols
Cardiovascular drugs	Antihistamines	Anticonvulsants
Foreign bodies	Pesticides	Pesticides
Pesticides	Gastrointestinal drugs	Bites, envenomations
Topical drugs	Plants	Antihistamines
Alcohols	Dietary supplements	Cosmetics, personal care products
Vitamins	Antimicrobial drugs	Stimulants

^aIn decreasing order of frequency and based on 2,577,577 substances reported in 2,165,142 cases.

^bData from reference 2.

TABLE 5-3. Rate of Positive Urine Drug Screens for the Combined U.S. Workforce During 2014 as Reported by a Nationwide Laboratory Service for 9.1 Million Tests³

SUBSTANCE	PERCENTAGE OF POSITIVE URINE DRUG SCREENS ^a
Marijuana	1.90
Amphetamines	0.90
Oxycodones	0.80
Benzodiazepines	0.71
Opiates	0.39
Cocaine	0.24
Barbiturates	0.22
Methadone	0.18
6-acetylmorphine (heroin)	0.03
Phencyclidine (PCP)	0.02

^aSome samples had multiple drugs identified.

In 2014, 27.7 million persons (10.5% of Americans) reported driving under the influence of alcohol at least once during the past year with 10.2 million (3.9%) driving under the influence of illicit drugs and 30.9 million (11.7%) under the influence of alcohol and illicit drugs.¹ Of the 1.5 million people on parole and 4.4 million adults on probation in 2014, 23–29%, respectively, were current illicit drug users, and 16–15% were dependent or abusers of illicit drugs or alcohol.¹ In a 2013 study of 1681 male arrestees in five U.S. sites, there was a variable rate of congruence between self-reporting of drug use and positive urine drug screening (83% marijuana, 63% methamphetamine, 50% heroin, and 38% cocaine).⁴

TABLE 5-4. Categories of Substances Abused as Claimed by High School Seniors During 2014⁵

SUBSTANCE	PERCENTAGE OF SURVEY RESPONDENTS	
	PAST YEAR (%)	EVER (%)
Alcohol (to a drunken condition)	41.4	49.8
Any illicit drug	38.7	49.1
Marijuana and hashish	35.1	44.4
Amphetamines	8.1	12.1
Hallucinogens	4.0	11.4
Opioids (excluding heroin)	6.1	9.5
Tranquilizers	4.7	7.4
Sedatives	4.3	6.8
Inhalants	1.9	6.5
3,4-methylenedioxy-N-methamphetamine (MDMA, Ecstasy)	3.6	5.6
Cocaine	2.6	4.6
Methamphetamine	1.0	1.9
Androgenic anabolic steroids	1.5	1.9
Heroin	0.6	1.0

For eighth-grade, tenth-grade, and twelfth-grade students, the lifetime prevalence of the use of illicit drugs during 2014 was 20%, 37%, and 49%, respectively (Table 5-4).⁵ During 2014, 51,966 people died from poisoning or overdose with 88 deaths (0.2%) occurring in children under five years of age.⁶ Poisoning became the leading cause of injury-related death in the United States in 2008, and 91% of these deaths in 2014 were caused by