

# Heroin Toxicity

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- ## Background

- Heroin (diacetylmorphine) is a semisynthetic narcotic derived from the opium poppy *Papaver somniferum*. It was first synthesized in 1874 and was originally marketed as a safer, nonaddictive substitute for morphine. Soon after its introduction, heroin was realized to be clearly as addictive as morphine, prompting the US government to institute measures to control its use. By 1914, the Harrison Narcotics Act prohibited the use of heroin without a prescription. In 1920, the Dangerous Drugs Act prohibited the use of heroin altogether, thus driving it underground.
- Afghanistan remains the world's largest cultivator of opium, accounting for more than 60% of the world's opium poppy cultivation. Central and South America—the main suppliers of opium products to the North America—account for about 7% of the world's opium poppy cultivation.
- In its pure form, heroin is a white powder with a bitter taste. However, samples are frequently mixed with other substances so dealers can maximize their profits. Because of these impurities and additives, street heroin samples have different purities and may appear in various hues, ranging from white to dark brown. Heroin is occasionally sold as a black, tarry substance, especially when crude processing methods are used to manufacture it. Heroin samples from South America appear to have the highest purity, reaching at times more than 70% purity.
- Heroin remains one of the most frequently abused narcotics in the United States. It may be injected intravenously ("mainlining"), snorted, or smoked. The presence of impurities may limit its absorption through mucous membranes, thus limiting its "rush" and "high" when sniffed or snorted.
- Heroin poisoning occurs most commonly when an individual accidentally overdoses on the drug. Poisoning may also occur in a "body packer," "body pusher," or "body stuffer." Body packers, also called "mules," are people who swallow and pack their GI tracts with bags of heroin in order to smuggle the illegal drug from one country to another. Body pushers conceal the drugs in their rectum and/or vagina. In both of these groups, the drugs are carefully packaged for safe passage, but poisoning occurs if the packages rupture. Body packing or pushing should be suspected in persons who are found unconscious at

airports, during international flights, or soon after a trip to endemic countries.

- Body stuffers, on the other hand, are people who ingest all the drugs in their possession in order to conceal the evidence from the police. Because these packages are typically not designed for safe GI transport, they easily rupture and frequently cause poisoning.

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- **Pathophysiology**

- Heroin is a highly addictive semisynthetic opioid that is derived from morphine. When used intravenously, it is three to five times more potent than its parent compound and is able to modulate pain perception and cause euphoria. Similar to morphine, heroin and its metabolites have mu, kappa, and delta receptor activity. In general, stimulation of the mu receptors results in analgesia, euphoria, CNS depression, respiratory depression, and miosis. Stimulation of the delta and kappa receptors also results in analgesia, but the kappa receptors are mostly involved in spinal analgesia. <sup>[1]</sup>
- Heroin, similar to morphine and other narcotics, reduces the brain's responsiveness to changes in carbon dioxide levels and hypoxia, thus resulting in respiratory depression. It also reduces peripheral vascular resistance (resulting in mild hypotension), causes mild vasodilation of the cutaneous blood vessels (resulting in flushing), and stimulates histamine release (resulting in [pruritus](#)). <sup>[1]</sup>
- Heroin's inhibitory effects on baroreceptor reflexes result in bradycardia, even in the face of hypotension. <sup>[1]</sup>
- Finally, heroin decreases gastric motility, inhibits the effect of acetylcholine on the small intestine, and diminishes the colonic propulsive waves, resulting in prolongation of gastric emptying time by as much as 12 hours, with consequent constipation. <sup>[1]</sup>
- The onset of action, peak effects, and duration of action vary with the different methods of heroin use. Onset of action occurs within 1-2 minutes with intravenous injection and within 15-30 minutes with intramuscular injection. Heroin's peak therapeutic and toxic effects are generally reached within 10 minutes with intravenous injection, within 30 minutes with intramuscular injection or when snorted, and within 90 minutes when injected subcutaneously. Analgesic effects generally last 3-5 hours. <sup>[1]</sup>
- Intravenously injected heroin creates a rush, or a sensation of intense pleasure, that begins within 1 minute of the injection and lasts from 1 minute to a few minutes. This rush is followed by a period of sedation that lasts about an hour. The initial rush is likely due to heroin's high

lipid solubility and rapid penetration to the brain. The half-life of heroin is 15-30 minutes. <sup>[1]</sup>

- Heroin is rapidly converted to 6-monoacetylmorphine (6-MAM) by the liver, brain, heart, and kidneys and may not be detected in the blood at the time of blood draw. 6-MAM is then converted to morphine. Morphine is metabolized by the liver and excreted as a glucuronide product or in its free form by the kidneys. Morphine's half-life is considerably longer than heroin's (ie, 2-3 h). A small amount of unchanged 6-MAM is excreted in the urine for up to 24 hours after heroin use. Because 6-MAM can originate only from heroin, its detection in the urine can mean only that the patient used either heroin or 6-MAM. <sup>[1]</sup>

## Epidemiology

### United States

The true prevalence of heroin use is probably much higher than reported in surveys because surveys depend on self-reporting and may not reach some of the persons who use heroin the heaviest. According to the US [Substance Abuse and Mental Health Services Administration](#) (SAMHSA) 2014 National Survey on Drug Use and Health (NSDUH), approximately 914,000 persons aged 12 years and older reported using heroin in the past year (about 0.3% of that age group); about 435,000 persons (about 0.2%) were current heroin users, and about 586,000 persons had a heroin use disorder. <sup>[2]</sup>

NSDUH estimates of current and past-year heroin use in 2014 were higher than those from 2002 to 2013. This rise may reflect increased use by adults aged 26 or older and, to a lesser extent, in young adults aged 18 to 25 years. <sup>[2]</sup>

### International

According to the 2014 report of the [United Nations Office on Drug and Crime](#) (UNODC), the global prevalence of opiate (heroin and opium) use was estimated at 0.4% of the population, or 12.8-20.2 million people. Levels of opiate use were much higher than the global average in Southwest Asia (1.21%), Eastern and Southeastern Europe (0.82%), and in Central Asia and Transcaucasia (0.81%). <sup>[3]</sup>

In its 2014 annual report, the [European Monitoring Centre for Drugs and Drug Addiction](#) (EMCDDA) estimated that there were 1.4 million regular opioid users in Europe, or 0.41 % of the adult population, with heroin being by far the most widely used opioid. The EMCDDA reported that although patterns and trends vary among countries, Europe may be witnessing a longer-term decline

in heroin use, for reasons that may include reduced interest in the drug and reduced availability of it.<sup>[1, 4]</sup>

### Mortality/Morbidity

Most fatalities from heroin overdose occur in long-term users, usually early in their third decade of life.<sup>[5, 6]</sup> Fatality rates are higher in patients who use alcohol and other drugs such as benzodiazepines and cocaine. Death is most commonly due to respiratory failure or asphyxiation.<sup>[6, 7, 8]</sup>

The US Centers for Disease Control and Prevention (CDC) reported that deaths from heroin overdoses increased by 26% from 2013 to 2014 and more than tripled from 2010 to 2014. Deaths increased from 1.0 to 3.4 per 100,000 population.<sup>[9]</sup>

About 3-7% of patients treated for heroin overdose require hospital admission because of complications such as pneumonia, noncardiogenic pulmonary edema, and infectious complications.<sup>[5]</sup>

### Race

Although heroin addiction has traditionally been viewed as a disease of the economically disadvantaged population, addiction among the affluent is grossly underreported. According to the [National Institute on Drug Addiction \(NIDA\)](#), little difference exists in lifetime heroin use among races and ethnic backgrounds.<sup>[10]</sup> According to the CDC, the racial/ethnic population with the highest death rate from heroin overdose in 2014 was non-Hispanic whites.<sup>[9]</sup>