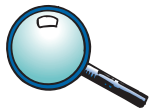


## InFocus



# Eaten Alive by Krokodil: A Disastrous New Drug of Abuse

By James R. Roberts, MD

Never underestimate the ingenuity and ignorance of illicit drug makers and drug users in search of their next high. They are always one step ahead of regulations and scientific evaluations of the product they abuse. Users of homemade illicit substances defy common sense, and are devoid of the ability to comprehend the haphazard nature of using unregulated street substances. Synthetic marijuana and bath salts are recent examples, but a new drug — krokodil — appears to be on the horizon. Despite initial reports of krokodil use in the United States, desomorphine, the basic ingredient, has not yet been verified in those few individuals suspected of using it.

This drug of abuse recently garnered a sullied reputation in the lay press and by word of mouth, but little has been written about it in the formal medical literature. The number of reports of krokodil use has increased, and many highlight serious if not fatal side effects.

Krokodil is a homemade injectable opioid that garnered its name from the excessive cutaneous harm associated with its use, including skin ulcerations, amputations, and discolored scale-like skin. The drug originated in Russia and more recently surfaced in some European countries, but concerns about its use and gargantuan serious side effects are turning up in the U.S. lay literature.

## Desomorphine Goes “Crocodile”

Gahr M, Freudenmann RW, et al  
*J Addict Dis*  
2012;31(4):407

This is one of the few formal systematic medical reviews that attempts to identify and clarify the available data for krokodil. This article states that the drug contains desomorphine, a substance with no current medical use. Desomorphine can be manufactured



**The self-brewed heroin substitute krokodil is made from readily available codeine by amateur drug aficionados. It is a mixture of the powerful and addictive opioid desomorphine, but contains a slew of toxic contaminants, including gasoline, lighter fluid, iodine, various hydrocarbons, and phosphorus, all substances used to extract and manipulate the opioid during stovetop manufacture. Desomorphine has a short half-life that adds up to rapid addiction, but the well-known soft tissue destruction comes from injected tissue toxic contaminants. Once confined to Russia and Europe, this horrendous poisonous concoction is now sporadically surfacing in the United States. Reports of it being sold on the street as heroin have appeared in the lay press, but only miniscule real scientific information is available in the medical literature.**

rather simply, and has been sold as a cheap substitute for heroin. It is a substance abuse problem primarily in Russia, but its actual popularity and spectrum of abuse remain unknown. Using krokodil has devastating dermatological lesions that make a patient's skin resemble that of a crocodile, hence the name.

The main culprit, desomorphine, is a drug originally developed in the 1930s as a substitute for morphine. Its pure form is five to 10 times more potent than morphine, and is a Schedule 1 substance. A true medical use never materialized.

The current concoction appears to be manufactured relatively easily in a pot on a stove from codeine tablets that are boiled with a diluting agent, often iodine, phosphorus, paint thinner, gasoline, or some other toxic substance, resulting in an impure and highly tainted suspension that contains desomorphine as the psychoactive agent. Unfortunately, no scientific medical analysis of the suspension currently exists. The chemical composition of krokodil actually varies because of the products used for manufacture. The purity and concentration of desomorphine also vary greatly. The suspension is, however, injected intravenously, accounting for its tremendous risk profile.

claim that this is a highly addictive substance that leads to a mean survival time of only two years after initial krokodil use. This has not been documented in the medical literature, but it is a commonly quoted statistic in the lay press.

Apparently the homemade production process is the main culprit, with tissue-toxic contaminants found in solutions contaminating desomorphine. The use of iodine, hydrocarbons, red phosphorous, and hydrochloric acid are the main tissue toxins, but desomorphine itself is highly addicting because of its short half-life, morphine-like euphoria, and rapid dependence. The drug reached its zenith in popularity in Russia in the early 2000s because of decreased heroin supplies, its low cost, and its highly sought-after euphoria. The short half-life requires that it be injected numerous times a day, quickly causing opioid addiction.

## Breaking Worse: The Emergence of Krokodil and Excessive Injuries among People who Inject Drugs in Eurasia

Grund JP, Latypov A, Harris M  
*Int J Drug Policy*  
2013;24(4):265

This is another review article that attempts to clarify the emergence and current use of krokodil. The authors note that homemade drugs are a popular substitute for heroin in Russia, and production of the drug has recently increased by “cooks” modifying numerous over-the-counter medications-containing codeine. The authors conducted a literature-based search of PubMed, Google Scholar, a variety of media search engines, and YouTube.

The major pharmacologic side effect appears to be a rapidly acquired narcotic addiction.

Contamination with various toxic byproducts injected by the user causes immediate damage to blood vessels, skin, and soft tissue, and bone. Systemic effects include multiorgan failure, and characteristics include abscesses, scarring, gangrene, skin slough, large scale skin scars, and widespread necrosis that may result in amputation. Reports from the media

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**Learning Objectives for This Month's CME Activity:** After participating in this CME activity, readers should be better able to evaluate patients who have used krokodil and identify the physical effects of krokodil use.

### Reader Feedback:

Readers are invited to ask specific questions and offer personal experiences, comments, or observations on InFocus topics. Literature references are appreciated. Pertinent responses will be published in a future issue. Please send comments to [emn@lww.com](mailto:emn@lww.com).





The offending drug, desomorphine, is characterized by a rapid onset and a short duration of effect, characteristics that lead to severe physical dependence and the need for frequent administration by the addicted individual. Addicts need multiple injections per day, and that results in the user's total dependence.

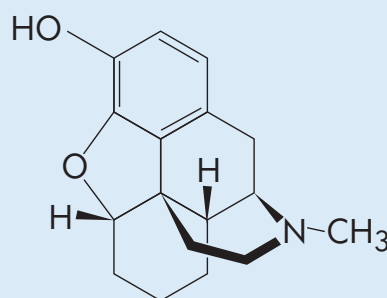
Desomorphine is produced, as the previous article also mentioned, by manipulating codeine products using a variety of chemicals, including iodine, hydrochloric acid, red phosphorous and organic solvents such as gasoline or paint thinner. Whether the homemade process actually produces desomorphine is open to debate.

A rather large clandestine drug-abusing community appears to exist in Russia, with more than 50 cities reporting the use krokodil and related substances. The homemade production of heroin substitutes is well known in the Russian drug culture. Black market opiates and stimulants have relatively limited availability in krokodil-affected areas, further prompting a homemade drug culture.

The harm associated with homemade krokodil injection is extreme and unprecedented. The most serious problem is venous, skin, and soft tissue injury, predominantly from caustic contaminants, followed by necrosis and gangrene. A variety of neurological, endocrine, and organ damage are also associated with the caustic chemicals and heavy metals common to krokodil production. HIV and hepatitis C infections are rising as well because of needle-sharing. The death rate from desomorphine addiction appears to be much higher than heroin. Opioid substance treatment such as methadone is banned in Russia, further complicating detoxification.

**Comment:** *The Los Angeles Times* recently reported that krokodil appeared in Phoenix, where physicians told Banner Good Samaritan Poison & Drug Information Control Center that "they spotted symptoms consistent with krokodil." Toxicology reports have not confirmed that, however, and *The Times* reported that the Drug Enforcement Administration called the Arizona cases anecdotal, adding that use in Alabama and Arkansas was never confirmed. (See FastLinks.)

Krokodil is truly a frightening drug. It has been termed a flesh-eating street drug, and Google Images is chockfull of flesh eaten away to the bone. (See FastLinks.) No desomorphine analysis is available, and all reports are currently anecdotal. Drug testing of those using it would likely not be positive for opioids, but even that is not yet certain. Its close chemical



#### Common Names

Permonid (brand name), crocodile, krokodil

#### Effects Classification

Opioid, sedative, stimulant

#### Chemical Name

4,5-alpha-epoxy-17-methylmorphinan-3-ol


#### Description

Desomorphine is an opioid that has gained attention because of low-quality black market synthesis in Russia, where it began being sold as krokodil starting in 2010. Synthesized from codeine (using iodine and red phosphorous in a process similar to that used for making street methamphetamine), the final street product is often contaminated with corrosive, toxic chemicals. Heavy opioid users who inject street desomorphine can experience serious medical problems. News reports sometimes refer to desomorphine as "flesh-eating" because of these problems.

**This information on krokodil came from the Internet website, [www.erowid.com](http://www.erowid.com), which is used for posting data on illicit drug use. It is supported by actual drug users detailing their experiences, good and bad, with various illegally used substances.**

phine from it. Apparently a large portion of the necrotizing effects are because of the oil or hydrocarbon that is still in the extracted drug. Some experts believe that it will have a rise similar to bath salts and synthetic marijuana, commonly called K2; both substances got their start in Europe before spreading to the United States. Perhaps one reason it has not gained acceptance in the United States is the ready availability of heroin and prescription narcotics. Users in Chicago purportedly thought they were buying heroin on the street, so another industry is likely in the offing.

The medical literature contains little information about the use or specifics of krokodil. Dozens of rather remarkable videos are posted on YouTube demonstrating the effects of this drug. (See FastLinks.) Most of the videos are not American, but they readily emphasize the issues involved, often in dramatic fashion.

Whether krokodil is currently available in the United States is not known. Further information can be found on [www.erowid.com](http://www.erowid.com), a fascinating Internet website that highlights drugs of abuse. Also read a fascinating Internet report on the drug at <http://bit.ly/KrokodilChicago>. 

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## FastLinks



■ Read *The Los Angeles Times* article on krokodil reports in Arizona at <http://bit.ly/AZkrokodil>.

■ See images of the devastating effects of krokodil at <http://bit.ly/KrokodilImages>.

■ Watch videos about krokodil at <http://bit.ly/KrokodilVideos>.

■ Read *The Procedural Pause*, EMN's newest blog by Dr. Roberts and his daughter, Martha Roberts, ACNP, CEN, at <http://bit.ly/ProceduralPause>.

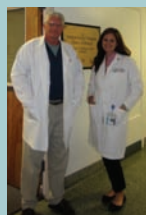
■ Read all of Dr. Roberts' past columns at <http://bit.ly/RobertsInFocus>.

■ Comments about this article? Write to EMN at [emn@lww.com](mailto:emn@lww.com).

**Dr. Roberts** is the chairman of emergency medicine and the director of the division of toxicology at Mercy Catholic Medical Center, and a professor of emergency medicine and toxicology at the Drexel University College of Medicine, both in Philadelphia.



## New Blogs, Videos, and Podcasts Every Month!



**New Blog Post!** This month in the [Procedural Pause](#): Finger Dislocation. By James R. Roberts, MD, and Martha Roberts, ACNP, CEN

Best approaches, pearls, and pitfalls for common ED procedures.



**New Video!** This month in [M<sup>2</sup>E Too! Mellick's Multimedia Edublog](#): Intussusception and Altered Mental Status. By Larry Mellick, MD

A multimedia creative commons of clinical pearls.



**New Blog!** Going [Global Travel with EM residents](#) from Palmetto Health Richland as they serve medical missions.

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Technology & Inventions: The [latest products and ideas](#) to improve EM practice.

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**New Podcast!** This month in [Everyday Medicine for Physicians: Super Users: A Frustrating Reality of ED Life](#). By Ryan Stanton, MD

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**New Blog Post!** [Little White Coats Follow Rick Pescatore](#) as he finishes medical school and starts a career in EM.

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