Kentucky Poison Control Center

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TOX-N-KY Provider Update

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Human Arsenic Poisoning

Arsenic is a natural component of air, water, and soil. Arsenic poisoning may occur as a result of any number of things, from occupational or environmental mishaps to intentional suicide or homicide. Historic outbreaks of arsenic poisoning from contaminated bread, beer, curry, and coffee illustrate some of its public health impact. Contaminated groundwater, soil, rice, and other foods remain the major sources of chronic exposure worldwide. There are many documented cases throughout history of mass arsenic poisonings. For instance, 400 residents in Hong Kong fell ill from contaminated bread from the Easing Bakery in 1857 when 2 bakery foremen tampered with the recipe. In Staffordshire England in 1900, 6,000 beer drinkers became ill, and 70 died from beer brewed with sugar made with arsenic-contaminated sulfuric acid. In 1998, 67 people in Wakayama, Japan were poisoned when they ate curry at a festival that had been deliberately contaminated with arsenic[1].

Clinically important toxicity is usually attributed to inorganic arsenic, particularly arsenite (As^{3+}) and arsenate (As^{5+}). Elemental arsenic is relatively nonpoisonous and organic arsenicals vary in toxicity. Most seafood-derived organic arsenicals have very low toxicity, but can confound laboratory testing when a positive for arsenic is resulted after testing. Arsenic trioxide is currently utilized as a therapeutic agent for acute promyelocytic leukemia, underscoring the narrow line between therapeutic and toxic exposure.[1,3,4]

Pharmacology / Toxicology-Pathophysiology

Trivalent arsenic binds sulfhydryl groups and inhibits key mitochondrial enzymes, especially pyruvate dehydrogenase, impairing oxidative metabolism and ATP production. Pentavalent arsenic substitutes for phosphate and uncouples oxidative phosphorylation. These effects drive cellular energy failure, oxidative stress, endothelial injury, QT prolongation, and ventricular dysrhythmias. Arsenic is rapidly absorbed after gastrointestinal exposure, distributes into liver, kidney, muscle, skin, and nervous tissue, undergoes hepatic methylation, and is cleared predominantly in urine. Because redistribution from blood occurs quickly, whole-blood arsenic is most useful only very early after acute exposure.[1,3]

Clinical Manifestations

Acute arsenic poisoning may begin within minutes to hours, with gastrointestinal symptoms such as nausea, vomiting, abdominal pain, and profuse diarrhea. Symptoms may then progress to hypovolemia, shock, encephalopathy, seizures, hepatitis, acute kidney injury, hemolysis, and malignant dysrhythmias. Peripheral neuropathy and weakness may emerge days to weeks later. Chronic toxicity is more indolent and should be suspected in patients with neuropathy, hyperpigmentation, raindrop hypopigmentation, palmar-plantar hyperkeratosis, anemia, vascular disease, or exposure-associated skin, bladder, or lung cancer.[1,3,4]

Diagnostic Testing for Arsenic Poisoning

For suspected acute inorganic arsenic exposure, obtain a spot urine arsenic with creatinine and, when feasible, a 24-hour urine arsenic collection using metal-free containers; speciation is important because seafood-derived arsenobetaine can falsely elevate total urine arsenic. It is recommended that patients avoid eating seafood for at least 48 hours before nonemergent testing to avoid a false positive arsenic. A whole-blood arsenic level may help if the exposure occurred the same day. Additional evaluation should include an electrocardiogram (ECG) with emphasis on looking at the QT interval, complete metabolic blood panel (CMP), complete blood count (CBC), and pulse oximetry. Abdominal radiography may identify radiopaque arsenic after large or intentional ingestions.[1,4]

Management

Management for arsenic poisoning begins with removing the patient from the source of arsenic, removal of contaminated clothing, irrigating exposed skin, and airway stabilization. Aggressive IV fluid management, use of antiemetics, and correction of any potassium, magnesium, or calcium abnormalities follows. Continuous cardiac monitoring is recommended for symptomatic patients. Patients with persistent vomiting, large or intentional ingestions, ECG abnormalities, hypotension, or multisystem toxicity should be admitted, often to an ICU.

Chelation Therapy for Arsenic Poisoning

In severely ill patients with suspected acute inorganic arsenic poisoning, chelation should not wait for laboratory confirmation. Dimercaprol (BAL) was a preferred chelator for arsenic poisoning, but it is no longer being produced in the United States. An oral chelator, 2,3-dimercaptosuccinic acid (succimer) is currently the predominant chelator used in arsenic poisoning. Dosing of succimer is 10 mg/kg orally three times daily for 5 days, followed by 10 mg/kg twice daily for 14 days when ongoing treatment is indicated. Early toxicology consultation by a poison center is advised if chelation is going to be needed. This is particularly important if early whole-blood arsenic exceeds 5 mcg/L, spot urine exceeds 200 mcg/L or 100 mcg/g creatinine, or 24-hour urine exceeds 200 mcg/L arsenic. For chronic toxicity, exposure cessation and investigation are essential, and chelation decisions should be individualized.[1,2,]

Fruit Juices, Rice, and other Sources of Arsenic

There are a plethora of sources where someone may be exposed to high enough levels of arsenic to be toxic. Some examples of inorganic arsenic sources include animal feed, dyes, fireworks, oil, herbicides, mining, rodenticides, wood preservatives, and more. Some organic arsenic examples are seafood, melarsoprol, and thiacetarsamide, a heartworm therapy for dogs. The most common sources of arsenic toxicity involve contamination of water sources, soil, and ultimately food.[1]

Arsenic can leach from certain minerals and industrial waste into a drinking water supply. Per the FDA, if home drinking water comes from a well, it is strongly encouraged to test the water for arsenic either every spring or early summer to ensure it is safe. Arsenic levels in the water supply should not exceed 10 parts per billion, or 0.01 mg/mL.[7] Before 2001, water was permitted to contain up to 50 parts per billion (ppb) of arsenic; however, this limit was reduced to 10 ppb after epidemiological evidence indicated an increased risk of lung and bladder cancer associated with elevated arsenic exposure. [8,9]

Along with water, fruit juices may also contain arsenic, thus leading to additional recommendations by the FDA. Arsenic makes its way into our fruit juice by two different mechanisms. As mentioned earlier, arsenic exists naturally in our soil. When fruit plants grow and obtain their nutrients from the soil, they can also absorb arsenic. Second, many historic pesticides used for crops contain arsenic. The fruits that are most often affected by arsenic are apples and grapes. The juice from apples and grapes comprise a significant ingredient in the making of fruit juices. Like water, fruit juices are not supposed to contain more than 10 ppb of arsenic. Tips from the FDA to limit the risk of arsenic toxicity from fruit juice include; avoiding juice altogether for children less than 1 year old, or choosing 100% juice with no added sugars, diluted with water.[6]

One food product that is known to contain higher levels of arsenic than most other foods is rice. Rice is grown in continually flooded paddies, leading to a greater chance of soil-containing arsenic being absorbed into the rice. This can happen 10 times faster than other grains because of the way it is grown. Another issue arises from the chemicals we have used historically in the United States as pesticides on crops. Much of the rice in the United States is grown in southeastern states, in the same region where there was extensive cotton production pre-Civil War. The use of arsenical pesticides was a common practice to control the boll weevil that fed on cotton crops. Unfortunately this also led to accumulation of arsenic in the soil over time.[5]

Even though there is a possibility of rice being contaminated with toxic amounts of arsenic, it is still considered safe to consume. There are a few things that can be done at home to ensure the rice you eat will not lead to negative health effects from arsenic. The most often cited recommendation is simply cooking rice like pasta. The FDA states that using 6-10 parts water for one part of rice may reduce arsenic levels by an average of 50%. Although white rice lacks the same nutrition as brown rice, white rice typically contains less arsenic, so may be safer to consume in a diet that includes a lot of rice. Applying these methods, along with limiting how often you eat rice, can certainly lower the chances of possible arsenic toxicity.

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Arsenic and Old Taxidermy

In 2023, the Delbridge Museum of Natural History closed its doors to the public, nearly 40 years after opening and displaying a large collection of taxidermy. The collection included some 152 mounts from six different continents; originally the trophy hunts from a hardware salesman in Sioux Falls, South Dakota. The museum had the taxidermy tested and found that 79% of them contained high enough arsenic levels to be considered toxic. In Feb. 2025 the collection was parsed out among 3 different museums to find permanent homes where the taxidermy could be cared for and the risk of arsenic minimized to curators or the public.

The use of arsenical soaps to preserve taxidermy was widely used starting in the late 1800's, all the way up until 1980. A combination of arsenic in the form of arsenic oxide, camphor, soap, lime, carbonate of potash, and distilled water was employed by museums around the world to preserve all manner of taxidermy. The soap was rubbed on the inside of the skins to keep insects from deteriorating the specimens, but it worked well to keep the animal from breaking down over time as well. Older animals did start to breakdown, however, and the arsenic came through the skins as a white powder at the base of the hair or feathers, around eyes and other openings or foot pads. The powder could be dislodged from the animal when being moved or handled and could easily be dispersed into the air and breathed in, or transferred by way of dermal contact. The potential for arsenic poisoning was considered to be significant enough to ban the use of arsenical soaps for preservation by 1980.

Museums around the world still display taxidermy that has been preserved using arsenic, but are careful to use masks and gloves when moving the mounts, and displaying them in bags or enclosed glass containers to prevent dispersal of the arsenic dust to a wider arena, keeping both employees and visitors safe from exposure to the toxic chemical.

References:

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In 2025, poison centers responded to 35,501 human exposure cases from Kentucky

86.6% single substance exposures.

12.2% suspected suicides.

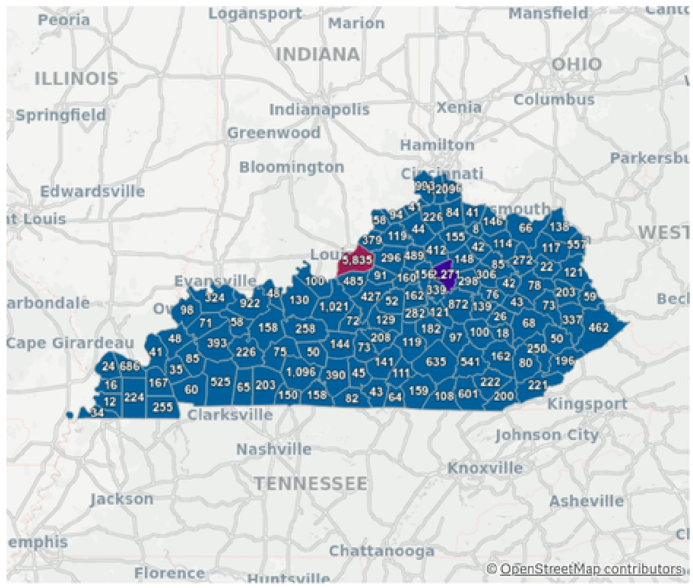
10.5% resulted in serious outcomes. (Moderate effect, Major effect, Death or Death, Indirect)

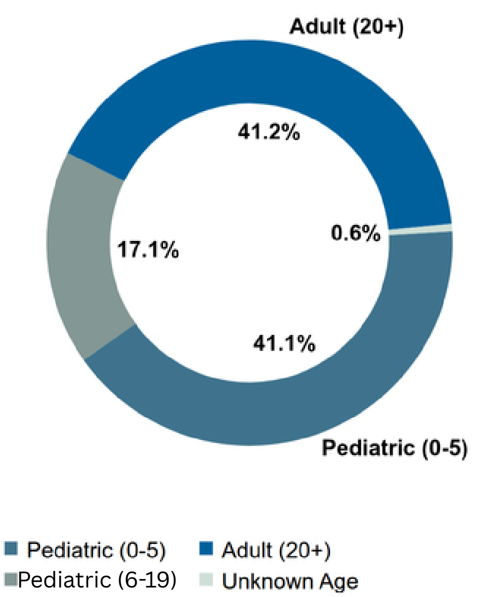
0.09% (32) resulted in death.

89.9% occurred at a residence.

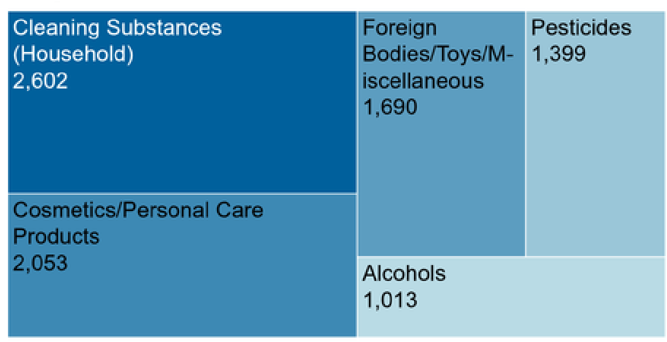
66.4% were managed on site.

25.1% cases originated from a Health Care Facility.

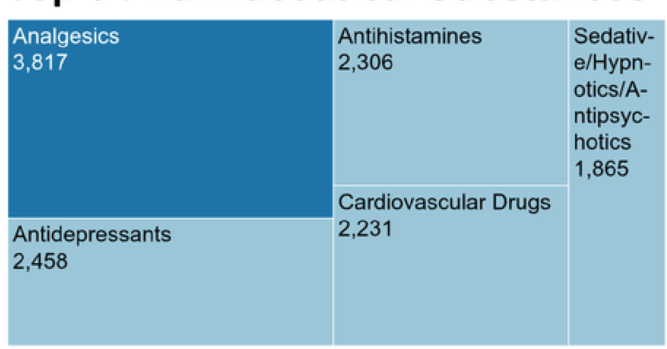




Top 5 Non-Pharmaceutical Subs...



Top 5 Pharmaceutical Substances



In addition to human exposure cases, 3,879 information requests were addressed.