

Arsenic

PROTOCOL CHECKLIST

- Enter available information into Merlin upon receipt of initial report
- Review information on the poisoning and its epidemiology ([see section 2](#)), case definition ([see section 3](#)), and laboratory testing ([see section 4](#))
- Contact provider ([see section 5](#))
- Interview patient(s) ([see section 5B](#))
 - Review poisoning facts ([see section 5B.2](#))
 - Complete case report form
 - Exposure information
 - Symptoms
 - Ask about exposure to relevant risk factors ([see section 5B.2](#))
 - Travel
 - Consumption of fish or shellfish in the 3 days before testing
 - Exposure to agricultural pesticides
 - Consumption of well water
 - Taking homeopathic medicines
 - Exposure to Copper chromated arsenate (CCA)-treated wood
 - Smoking
 - Other possible arsenic sources
 - Intentional poisoning
 - Occupational exposure
 - Provide education on controlling further spread ([see section 6](#))
 - Test well water for arsenic
 - Stop smoking
 - Ensure a well balanced diet
 - Follow warnings when using CCA-treated lumber
 - Wash hands after playing on CCA-treated lumber play equipment
 - Consider annual application of a sealant on any existing CCA-treated lumber surfaces
 - Limit sun exposure
 - Discuss concerns about occupational exposures with supervisor
 - Contact your physician if necessary
 - Address case-patient's questions or concerns
 - If exposure is thought to be intentional and criminal, report to local law enforcement immediately
- Follow-up on special situations, including possible intentional contamination ([see section 7](#))
- Enter additional data obtained from interview into Merlin ([see section 5D](#))

Arsenic Poisoning

1. DISEASE REPORTING

A. Purpose of reporting and surveillance

1. To determine if there is a source of intoxication of public health concern (e.g., a water source, workplace exposure, homeopathic medicines, exposure to CCA-treated wood)
2. To prevent further or continued exposure
3. When the source of intoxication appears to pose a risk to only a few individuals, to inform those individuals how they can reduce their risk of exposure
4. Additionally, arsenic poisoning data may be used to:
 - Recognize patterns and evaluate trends in environmental conditions, population exposure and rates of disease
 - Measure impacts of public health interventions
 - Identify populations most affected or most vulnerable
 - Identify opportunities for research or public health interventions to reduce exposures to potential environmental health hazards and prevent disease

B. Legal reporting requirements

Laboratories and physicians are required to report arsenic poisonings to the local county health department (CHD) within one working day of identification/diagnosis.

C. County health department investigation responsibilities

1. Begin investigation on the same day as notification.
2. Immediately notify Chemical Disease Surveillance Program (CDSP) by calling 850-845-4401 when a cluster (two or more related cases) of arsenic poisoning is suspected. Department of Health (DOH) epidemiologists and toxicologists are available to assist CHDs with investigations as needed.
3. Enter into the Merlin reporting system. Attach case report form (CRF) and other related documents (e.g., Medical Examiners report) in Merlin.
4. Direct the case-patient or physician to Florida Poison Information Center Network (FPICN) (available 24/7) for more information, 1-800-222-1222.

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2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic agent*

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. CCA is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

- **Acute exposure:** Acute arsenic poisoning occurs from the ingestion of arsenic regardless of intent and rarely occurs in the workplace today; it usually results from unintentional ingestion, suicide, or homicide. The fatal dose of ingested arsenic in humans is difficult to determine from case reports and depends upon many factors (e.g., solubility, valence state).
- **Chronic exposure:** Chronic exposure occurs from the continued ingestion of arsenic over a period of time. Manifestations of chronic arsenic ingestion depend on both the intensity and duration of exposure. Skin lesions and peripheral neuropathy are the hallmarks of arsenic ingestion, and their presence should result in an aggressive search for this etiology. Neuropathy can occur insidiously in chronic toxicity without other apparent symptoms. However, careful evaluation usually reveals signs of multi-organ and multi-system involvement such as anemia, leukopenia, skin changes, or elevated liver function tests.

B. Description of illness

Commonly reported initial symptoms include numbness, tingling and "pins and needles" sensations in the hands and feet in a symmetrical "stocking-glove" distribution, and muscular tenderness in the extremities. Clinical involvement spans the spectrum from mild paresthesia with preserved ambulation to distal weakness, quadriplegia, and, in rare instances, respiratory muscle insufficiency. Other findings in acute arsenic poisoning may include fever and facial edema.

Arsenic intoxication may affect multiple organ systems. **Acute exposure** to toxic amounts of arsenic may present signs and symptoms such as vomiting, abdominal pain, diarrhea, light-headedness, headache, weakness, and lethargy. These signs and symptoms may rapidly lead to dehydration, hypotension, pulmonary edema, congestive heart failure, and shock. Different clinical manifestations might follow, including dysrhythmias (prolonged QT, T-wave changes), altered mental status, and multisystem organ failure, which may ultimately lead to death.

Manifestations of **chronic arsenic** ingestion depend on both the intensity and duration of exposure. An intense exposure of several milligrams a day results in anemia, neuropathy, and hepatotoxicity within a few weeks to months. Hematologic and neurologic signs may occur after a similar latency period. Skin lesions, however, take longer to manifest (3–7 years for pigmentation changes and keratoses; up to 40 years for skin cancer) and may occur after lower doses than those causing neuropathy or anemia.

C. Reservoirs

Tobacco smoke, seafood, some agricultural pesticides, well water with high arsenic levels, CCA-treated wood and some homeopathic, naturopathic, or folk remedies are the sources of arsenic poisoning.

D. Modes of transmission

Transmission may occur through smoking, consumption of seafood and contaminated agricultural products, consumption of well water with high arsenic levels, contact with CCA-treated wood and contact or consumption of homeopathic, naturopathic or folk remedies.

E. Incubation period

Not Applicable

F. Period of communicability

Not communicable person-to-person

G. Treatment

Washing arsenic residues from the skin or eyes usually reduces the irritant effect. If arsenic trioxide is swallowed, measures can be taken to remove it from the body. In severe cases, medicines called chelating agents are given to remove arsenic from the body and eliminate it in the urine. Severely affected individuals must be hospitalized. In some cases, permanent nerve damage can result even if chelation therapy is used.

In cases of ingestion, do not induce emesis. Aggressive decontamination with gastric lavage is recommended within one hour of ingestion of a life-threatening amount of poison.

For additional treatment information concerning arsenic, consult the FPICN (available 24/7) 1-800-222-1222.

H. Prophylaxis

None indicated

I. Arsenic poisoning in Florida

Arsenic poisoning became a reportable condition in Florida on November 24, 2008. From 2009 through 2013, 48 cases of human arsenic poisonings were reported in Florida. There is no apparent seasonality to arsenic poisoning.

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3. CASE DEFINITION**A. Clinical description**

Arsenic intoxication may affect multiple organ systems. Acute exposure to toxic amounts of arsenic may present signs and symptoms such as vomiting, abdominal pain, diarrhea, light-headedness, headache, weakness, and lethargy. These signs and symptoms may rapidly lead to dehydration, hypotension, pulmonary edema, congestive heart failure and shock. Different clinical manifestations might follow, including dysrhythmias (prolonged QT, T-wave changes), altered mental status, and multisystem organ failure, which may ultimately lead to death.

B. Laboratory criteria for diagnosis

Elevated inorganic or total urinary arsenic levels (>50 µg/L total for a 24-hour urine) as determined by laboratory test.

If Laboratory results for urine are reported in µg As/g creatinine (mcg/g creat) and are >15 µg/g creatinine, then results must be converted to µg As/Liter of urine using the following formula and conversion factor.

$$\frac{\text{_____}}{\text{given}} (\mu\text{g As/g creat}) \times \frac{\text{_____}}{\text{given}} (\text{mg creat/dL}) \times 0.01 = \frac{\text{_____}}{\text{calculated}} (\mu\text{g As/Liter urine})$$

Positive total arsenic laboratory test results from specimens taken within 72 hours of consumption of seafood are **not** acceptable.

C. Case classification

Confirmed: A clinically compatible case that meets the laboratory criteria for diagnosis

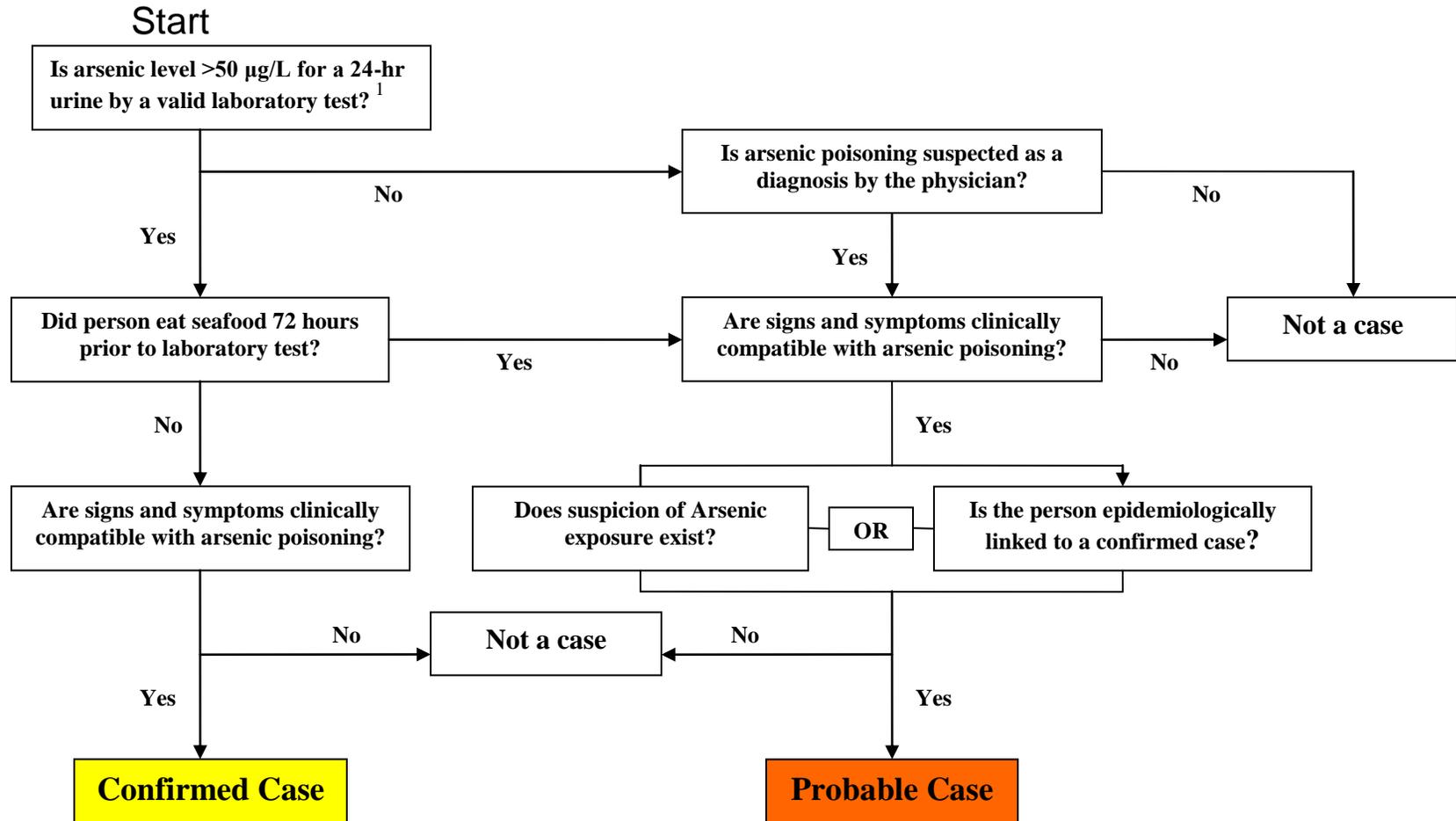
Probable: A clinically compatible case in which a high index of suspicion, (patient's exposure history regarding location and time) exists or an epidemiologic link exists between this case and a confirmed case

D. Comment

Most cases of arsenic-induced toxicity in humans are due to exposure to inorganic arsenic. Another form, organic arsenic, can be detected after consumption of fish and shellfish and is **NOT** toxic. Because total arsenic tests do not distinguish between the organic arsenic and inorganic arsenic, speciation is required. A positive total arsenic laboratory test result from specimens taken within 72 hours of consumption of seafood does not meet the laboratory criteria.

A copy of laboratory test results must accompany the paper case report form.

Arsenic Poisoning Flow Chart:



¹ Valid Laboratory test: Only urine (24 hrs) and urine creatinine tests are valid for arsenic.

4. LABORATORY TESTING

A. Criteria for diagnosis

The criteria for diagnosis is made by identifying arsenic in the urine at concentration levels >50 $\mu\text{g/L}$. Only urine (24 hrs) and urine creatinine tests are valid for arsenic. Speciations for inorganic and organic arsenic is not required, but if available, use only inorganic arsenic level to determine arsenic poisoning.

$$\frac{\text{Given}}{\text{Given}} (\mu\text{g As/g creat}) \times \frac{\text{Given}}{\text{Given}} (\text{mg creat/dL}) \times 0.01 = \frac{\text{Calculated}}{\text{Calculated}} (\mu\text{g As/Liter urine})$$

Further explanation can be found at:

http://www.myfloridaeh.com/medicine/Chemical_Surveillance/Reporting_Guidelines.htm

B. Services available at the Bureau of Public Health Laboratories (BPHL)

The capability to analyze both biological (urine) and environmental specimens (water, soil) for arsenic is available at **BPHL-Jacksonville only**.

C. Testing requests

The customer requests the container (for urine and water) and it is shipped from the laboratory; the soil is generally collected in a plastic bag, which is also available from the laboratory, or the customer may supply their own. The cost is to the customer: arsenic in water at a cost of \$25.00 per sample and urine \$50.00 per sample. Please contact the Jacksonville Laboratory for testing and additional information on sampling and testing.

Mailing addresses for Jacksonville Laboratory

1217 Pearl Street
Jacksonville, FL 32202

P.O. Box 210
Jacksonville, FL 32231

Contact by phone or Fax

Telephone: (904) 791-1500

Fax: (904) 791-1567

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5. CASE INVESTIGATION

A. Contact the physician or hospital

1. Confirm that an arsenic poisoning has been diagnosed in the reported case.
2. Obtain the following:
 - a. Date of onset
 - b. Signs and symptoms
 - c. Predisposing conditions (e.g., immunosuppression)
 - d. Tests performed

- e. Treatment
- 3. Ask what information has been given to the patient, including whether the patient knows about the diagnosis.
- 4. Obtain as much demographic information as possible, including contact information (home, cellular, pager and/or work numbers). Ask how and where the patient can be contacted (i.e., at hospital or home).
- 5. Notify the physician that you will be contacting the case as DOH follows-up on all cases of arsenic poisoning to assess exposure and to identify potential means for preventing further poisonings. It may also be appropriate at this point to determine if the physician has any concerns about the health department contacting the case.

B. Interview the case

The county health department (CHD) conducts case follow-up and investigation including the collection of additional situational and risk-related information. Collect information using the Environmental Health Acute Arsenic Poisoning Case Report Form (CRF). The case report form and guidelines for completing the form are found at:

http://www.myfloridaeh.com/medicine/Chemical_Surveillance/Reporting_Guidelines.htm.

1. Contact the patient to complete an interview as soon as possible after reporting, to optimize recall.
 - a. Make at least three phone call attempts to reach the case.
 - b. Calls should be made at different times of the day, with at least one attempt in the evening.
2. Items to cover during interview include:
 - a. Provide a brief background on arsenic poisoning, including possible modes of exposure, incubation period, symptoms, etc.
 - b. Activities during exposure period:
 - i. Travel outside Florida or the U.S.; determine dates of travel
 - ii. Consumption of fish or shellfish in the three days before patient was tested
 - iii. Exposure to agricultural pesticides
 - iv. Consumption of well water
 - v. Taking homeopathic medicines
 - vi. Exposure to CCA-treated wood
 - vii. Smoking
 - viii. Other possible arsenic sources
 - ix. Intentional poisoning
 - x. Work related exposures
 - c. Demographic information
 - d. Health Effects and Medical Information
 - e. Test and Laboratory Information
 - f. Provide basic instruction on reducing the risk of exposure.
 - g. Ask if other household members or co-workers are experiencing similar symptoms.

C. Environmental evaluation

Environmental investigations, when necessary, will generally focus on documenting exposure and any suspected health complaints in order to complete the information on the case report form. Field investigations may also involve gathering information for determining if there is an ongoing public health threat or if additional individuals have been exposed and are ill. CHD staff must try to identify the chemicals involved in the exposure, although confirmation may have to come from an outside source, such as a laboratory. When multiple people are potentially exposed, the CDSP may be able to provide CHDs with incident specific guidance for gathering the necessary information in a more efficient manner. CHD staff should coordinate field activities with the CDSP program.

D. Merlin data entry:

Create a case in Merlin under disease code **ARSENIC POISONING-98080**. Enter the data collected into Merlin, being sure to include all required fields on the Basic Data screen, and attach all relevant labs and the completed case report form. Please attach **ALL** labs received via electronic laboratory reporting (ELR).

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6. CONTROLLING FURTHER SPREAD

A. Patient/ household education on prevention recommendations

Prevention tips for arsenic exposure: (CDC)

- If your drinking water source is a private well, and you suspect higher arsenic concentrations, have your well water tested. Use bottled water for drinking until the well is shown to be safe or until appropriate water filtration systems are put in place to remove the arsenic.
- Stop smoking. Cigarettes contain arsenic.
- Ensure a well balanced diet rich in selenium, other antioxidants, and folate to facilitate in the clearance of arsenic.
- When using CCA-treated lumber in nonresidential applications, follow the warnings regarding the wearing of personal protective equipment such as gloves, eye, and respiratory protection.
- Have children wash their hands after playing on CCA-treated lumber play equipment.
- Consider annual application of a sealant on any existing CCA-treated lumber surfaces.
- Limit sun exposure and use sunscreen to help decrease the risk of skin cancer. Exposure to arsenic and UVB radiation together may further increase the risk of developing skin cancer.
- Discuss your concerns regarding arsenic and prevention of hazardous exposures at the workplace with your employer and/or workplace health and safety representative.
- If you think arsenic is making you sick, contact your physician to seek medical assistance and contact your county health department to report arsenic poisoning.

B. Isolation of cases

None indicated

C. Management of contacts

None indicated

D. Laboratory testing during outbreaks

Same as for one case of arsenic poisoning

E. Food or water is implicated as the source of the outbreak

Stop consuming food or water that are contaminated with arsenic.

Note: The Florida Department of Health performs surveillance for arsenic poisoning and prevents poisonings through education. According to Florida statute, public water supplies must be tested for arsenic. Florida drinking water standards for arsenic set the minimum concentration level (MCL) at 10 micrograms per liter (µg/L). This level is set to protect Floridians against the risk of arsenic poisoning. Drinking water from private wells, particularly in areas known to have high levels of arsenic in ground or well water, should be tested by the homeowner, specifically for arsenic.

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7. MANAGING SENSITIVE SITUATIONS

If arsenic poisoning is thought to be intentional, contact the Bureau of Epidemiology immediately for possible coordination with the Florida Department of Law Enforcement.

8. IMPORTANT LINKS**A. Food and Waterborne Disease Program—Investigation Tools**

<http://www.floridahealth.gov/diseases-and-conditions/food-and-waterborne-disease/index.html>

9. REFERENCES

- *A. ATSDR, Case Studies in Environmental Medicine (CSEM), Arsenic Toxicity Clinical Assessment, Retrieved from <http://www.atsdr.cdc.gov/csem/csem.asp?csem=1&po=12> on October 30, 2013.
- B. CDC, Facts about arsine, Retrieved from <http://emergency.cdc.gov/agent/arsine/facts.asp> on October 30, 2013.
- C. Agency for Toxic Substances and Disease Registry (ATSDR). *Case Studies in Environmental Medicine. Arsenic Toxicity*. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1990.
- D. Concha G, Vogler G, Lezcano D, *et al.* Exposure to inorganic arsenic metabolites during early human development. *Toxicol Sci* 1998;44:185–90.