MAYO CLINIC LABORATORIES

Test Definition: SPAS

Arsenic Speciation, Random, Urine

Overview

Useful For

Diagnosing arsenic intoxication using random urine specimens

Testing Algorithm

Total arsenic will be performed first. If the total arsenic concentration is 10 mcg/L or greater, then speciation will be performed and reported. If total arsenic is below 10 mcg/L, total arsenic will be reported as less than 10 mcg/L and speciation will not be performed.

Special Instructions

- Metals Analysis Specimen Collection and Transport

Method Name

Triple-Quadrupole Inductively Coupled Plasma Mass Spectrometry (ICP-MS/MS)/Ion Chromatography Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)

NY State Available

Yes

Specimen

Specimen Type

Urine

Specimen Required

Patient Preparation:

1. For 48 hours before collection, patient **should not** eat seafood.
2. High concentrations of gadolinium and iodine are known to potentially interfere with most inductively coupled plasma mass spectrometry-based metal tests. If either gadolinium- or iodine-containing contrast media has been administered, **a specimen should not be collected for 96 hours**.

Supplies:

-Urine Tubes, 10 mL (T068)

-Sarstedt Aliquot Tube 5 mL (T914)

Collection Container/Tube: Clean, plastic urine collection container

Submission Container/Tube: Plastic vial or a clean, plastic aliquot container with no metal cap or glued insert

Specimen Volume: 5 mL

Collection Instructions:

1. Collect a random urine specimen.
2. See Metals Analysis Specimen Collection and Transport for complete instructions.

Specimen Minimum Volume

3 mL

Reject Due To

All specimens will be evaluated at Mayo Clinic Laboratories for test suitability.

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Urine	Refrigerated (preferred)	28 days	
	Ambient	72 hours	
	Frozen	28 days	

Clinical & Interpretive

Clinical Information

Arsenic (As) exists in a number of different forms; some are toxic, while others are not. The toxic inorganic forms are arsenite (As[3+], As[III]) and arsenate (As[5+], As[V]), and their partially detoxified metabolites are monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). As(III) is more toxic than As(V), and both are more toxic than MMA and DMA. The biologic half-life of inorganic arsenic is 4 to 6 hours, while the biologic half-life of the methylated metabolites is 20 to 30 hours. Target organs of As(III)-induced effects are the heart, gastrointestinal tract, skin and other epithelial tissues, kidney, and nervous system.

Inorganic arsenic is carcinogenic to humans. Symptoms of chronic poisoning, called arseniasis, are mostly insidious and nonspecific. The gastrointestinal tract, skin, and central nervous system are usually involved. Nausea, epigastric pain, colic abdominal pain, diarrhea, and paresthesias of the hands and feet can occur.

Nontoxic, organic forms of arsenic are present in many foods. Arsenobetaine and arsenocholine are the 2 most common forms of organic arsenic found in food. The most common foods that contain significant concentrations of organic arsenic are shellfish and other predators in the seafood chain (cod, haddock, etc). Some meats, such as meats from chickens that have been fed seafood remnants, may also contain the organic forms of arsenic.

Following ingestion of arsenobetaine and arsenocholine, these compounds undergo rapid kidney clearance to become concentrated in the urine. Organic arsenic is completely excreted within 1 to 2 days after ingestion, and there are no residual toxic metabolites. The biologic half-life of organic arsenic is 4 to 6 hours.

For reporting purposes, the concentrations of the inorganic forms (As[III] and As[V]) along with the methylated forms (MMA and DMA) will be summed and reported together as 'Inorganic' arsenic. This is consistent with how the biological exposure index reference range is reported.

Reference Values

Toxic Arsenic:
<35 mcg/L
Reference values apply to all ages.

Arsenic Speciation Interpretive Information:
The toxic arsenic concentration represents the sum of the inorganic and methylated arsenic species. The reference value for toxic arsenic is <35 mcg/L. This value is based on the ACGIH Biological Exposure Index (BEI), which does not include the nontoxic organic arsenic.

Interpretation

The quantitative reference range for fractionated arsenic applies only to the inorganic forms. Concentrations of 20 mcg inorganic arsenic per liter or higher are considered toxic.

There is no limit to the normal range for the organic forms of arsenic since they are not considered toxic and are normally present after consumption of certain food types. For example, a typical finding in a urine specimen with total 24-hour excretion of arsenic of 350 mcg/24 hr would be that more than 95% is present as the organic species from a dietary source, and less than 5% is present as the inorganic species. This would be interpreted as indicating the elevated total arsenic was due to ingestion of the nontoxic form of arsenic, usually found in seafood.

A normal value for blood arsenic does not exclude a finding of elevated urine inorganic arsenic, due to the very short half-life of blood arsenic.

Cautions

Consumption of seafood before collection of a urine specimen for arsenic testing is likely to result in a report of an elevated concentration of organic arsenic, which can be clinically misleading.

Clinical Reference

1. Caldwell KL, Jones RL, Verdon CP, Jarrett JM, Caudill SP, Osterloh JD. Levels of urinary total and speciated arsenic in the US population: National Health and Nutrition Examination Survey 2003-2004. J Expo Sci Environ Epidemiol. 2009;19(1):59-68. doi:10.1038/jes.2008.32
2. Agency for Toxic Substances and Disease Registry. Toxicological profile for arsenic. US Department of Health and Human Services. 2007. Available at www.atsdr.cdc.gov/ToxProfiles/tp2.pdf
3. Strathmann FG, Blum LM. Toxic elements. In: Rifai N, Chiu RWK, Young I, Burnham CD, Wittwer CT, eds. Tietz Textbook of Laboratory Medicine. 7th ed. Elsevier; 2023:chap 44

Performance

Method Description

The metal analyte of interest is analyzed by inductively coupled plasma mass spectrometry and triple-quadrupole inductively coupled plasma mass spectrometry.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Monday through Friday

Report Available
3 to 5 days

Specimen Retention Time
14 days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Superior Drive

Fees & Codes

Fees
- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification
This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information
82175

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
SPAS	Arsenic Speciation, Random, U	54454-4

Result ID	Test Result Name	Result LOINC® Value
607692	Inorganic Arsenic (Toxic)	12481-8
607693	Methylated Arsenic (Toxic)	53779-5
607694	Organic Arsenic (Non-Toxic)	53778-7
609405	Toxic Arsenic Concentration	96250-6
607691	Total Arsenic Concentration	5586-3