

## Overview

### Useful For

Preferred specimen type for [biomonitoring nickel exposure](#)

### Special Instructions

- [Trace Metals Analysis Specimen Collection and Transport](#)

### Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
NIUC	Nickel/Creat Ratio, U	No	Yes
CRETR	Creatinine, Random, U	No	Yes

### Method Name

NIUC: [Inductively Coupled Plasma-Mass Spectrometry \(ICP-MS\)](#)

CRETR: Enzymatic Colorimetric Assay

### NY State Available

Yes

## Specimen

### Specimen Type

Urine

### Ordering Guidance

This test is preferred for the determination of nickel exposure, but serum concentrations can be used to verify an elevated urine concentration. For more information see NIS / Nickel, Serum.

### Specimen Required

**Patient Preparation:** High concentrations of gadolinium and iodine are known to interfere with most metal tests. If gadolinium- or iodine-containing contrast media has been administered, a specimen should not be collected for 96 hours.

**Supplies:** Urine Tubes, 10 mL (T068)

**Container/Tube:** Plastic, 10-mL urine tube or clean, plastic aliquot container with no metal cap or glued insert

**Specimen Volume:** 3 mL

**Collection Instructions:**

1. Collect a random urine specimen
2. See [Trace Metals Analysis Specimen Collection and Transport](#) for complete instructions.

**Reject Due To**

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

**Specimen Minimum Volume**

1.2 mL

**Specimen Stability Information**

Specimen Type	Temperature	Time	Special Container
Urine	Refrigerated (preferred)	28 days	
	Frozen	28 days	
	Ambient	14 days	

**Clinical & Interpretive****Clinical Information**

Nickel (Ni) is a highly abundant element with a silvery-white appearance. Nickel is frequently combined with other metals to form alloys and is essential for the catalytic activity of some plant and bacterial enzymes (including in several pathogenic and symbiotic species in humans) but has no known role in humans. Most nickel is used to make stainless steel.

Nickel and its compounds have no characteristic odor or taste. Ni compounds are used for Ni plating, to color ceramics, to make some batteries, and as catalysts that increase the rate of chemical reactions. One of the most toxic Ni compounds is nickel carbonyl, Ni(CO)<sub>4</sub>, which is used as a catalyst in petroleum refining and in the plastics industry, is frequently employed in the production of metal alloys (which are popular for their anticorrosive and hardness properties), in nickel-cadmium rechargeable batteries, and is used as a catalyst in hydrogenation of oils. Ni(CO)<sub>4</sub> is very toxic [and is lipid-soluble, allowing it to cross cell membranes](#).

Occupational exposure to Ni occurs primarily via inhalation of Ni compounds. Inhalation of dust high in Ni content has been associated with development of lung and nasal cancer.

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Food is the major source of exposure to Ni. Foods naturally high in Ni include chocolate, soybeans, nuts, and oatmeal. Individuals may also be exposed to Ni by breathing air, drinking water, or smoking tobacco containing nickel. Stainless steel and coins contain Ni. Some jewelry is plated with Ni or made from Ni alloys. Patients may be exposed to Ni in implanted devices including joint prostheses, sutures, clips, and screws made from Ni-containing alloys.

The most common harmful health effect of Ni in humans is an allergic reaction. Approximately 10% to 20% of the population is sensitive to it. The most serious harmful health effects from exposure to Ni, such as chronic bronchitis, reduced lung function, and cancer of the lung and nasal sinus, have occurred in people who have breathed dust containing certain Ni compounds while working in Ni refineries or Ni-processing plants. Urine is the specimen of choice for the determination of Ni exposure, but serum concentrations can be used to verify an elevated urine concentration.

Patients undergoing dialysis are exposed to Ni and accumulate Ni in blood and other organs; there appear to be no adverse health effects from this exposure. Hypernickemia has been observed in patients undergoing kidney dialysis. At the present time, this is considered to be an incidental finding as no correlation with toxic events has been identified. Routine monitoring of patients undergoing dialysis is currently not recommended.

### Reference Values

#### NICKEL:

0-17 years: not established

Males > or =18 years: <3.8 mcg/g creatinine

Females > or =18 years: <4.3 mcg/g creatinine

#### CREATININE:

16-326 mg/dL

Reference values have not been established for patients younger than 18 years of age.

### Interpretation

[Values of 3.8 mcg/g creatinine and higher for male patients or 4.3 mcg/g creatinine and higher for female patients represent possible environmental or occupational exposure to nickel \(Ni\).](#)

Ni concentrations above 50 mcg/g creatinine are of concern, suggesting excessive exposure.

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Hypernickemia, in the absence of exposure, may be an incidental finding or could be due to specimen contamination.

**Cautions**

Specimen collection procedures for nickel (Ni) require special collection containers, rigorous attention to ultraclean specimen collection and handling procedures, and analysis in an ultraclean facility. Unless all of these procedures are followed, increased urinary Ni results may be an incidental and misleading finding.

This test cannot determine the source compound (eg, Ni sulfate) responsible for the exposure.

**Clinical Reference**

1. Moreno ME, Acosta-Saavedra LC, Mez-Figueroa D, et al: Biomonitoring of metal in children living in a mine tailings zone in Southern Mexico: A pilot study. *Int J Hyg Environ Health*. 2010 Jul;213(4):252-258. doi: 10.1016/j.ijheh.2010.03.005
2. Schulz C, Angerer J, Ewers U, Heudorf U, Wilhelm M, Human Biomonitoring Commission of the German Federal Environment Agency: Revised and new reference values for environmental pollutants in urine or blood of children in Germany derived from the German Environmental Survey on Children 2003-2006 (GerES IV). *Int J Hyg Environ Health*. 2009 Nov;212(6):637-647. doi: 10.1016/j.ijheh.2009.05.003
3. US Department of Health and Human Services: Toxicological profile for nickel. Agency for Toxic Substances and Disease Registry. HHS; 2005. Accessed March 2020. Available at [www.atsdr.cdc.gov/ToxProfiles/tp15.pdf](http://www.atsdr.cdc.gov/ToxProfiles/tp15.pdf)
4. Rifai N, Horvath AR, Wittwer CT, eds: *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics*. 6th ed. Elsevier; 2018
5. Zambelli B, Ciurli S: Nickel and human health. In: Sigel A, Sigel H, Sigel R, eds. *Interrelations between Essential Metal Ions and Human Diseases*. *Metal Ions in Life Sciences*. Vol 13. Springer, Dordrecht; 2013:321-357

**Performance****Method Description**

Nickel:

This assay is performed on an inductively coupled plasma-mass spectrometer. Calibrating standards and blanks are diluted with an aqueous acidic diluent containing internal standards. Quality control specimens and patient samples are diluted in an identical manner. The mass range from 1 amu to 263 amu is rapidly scanned multiple times and ion counts tabulated for each mass of interest. Instrument response is defined by the linear relationship of analyte concentration versus ion count ratio (analyte ion count/internal standard ion count). Analyte concentrations are derived by reading the ion count ratio for each mass of interest and determining the concentration from the response line. (Unpublished Mayo method)

**Creatinine:**

The enzymatic method is based on the determination of sarcosine from creatinine with the aid of creatininase, creatinase, and sarcosine oxidase. The liberated hydrogen peroxide is measured via a modified Trinder reaction using a colorimetric indicator. Optimization of the buffer system and the colorimetric indicator enables the creatinine concentration to be quantified both precisely and specifically. (Package insert: Creatinine plus ver 2. Roche Diagnostics; V15.0, 03/2019)

**PDF Report**

No

**Specimen Retention Time**

14 days

**Performing Laboratory Location**

Rochester

**Fees & Codes****Test Classification**

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

**CPT Code Information**

83885

82570

**LOINC® Information**

Test ID	Test Order Name	Order LOINC Value
NIUCR	Nickel/Creat Ratio, Random, U	13472-6

  

Result ID	Reporting Name	LOINC®
CRETR	Creatinine, Random, U	2161-8
614553	Nickel/Creat Ratio, U	13472-6