

Overview

Useful For

- Diagnosis and management of patients with renal lithiasis:
- Predicting the likely composition of the stone, in patients who have a radiopaque stone, for whom stone analysis is not available
 - May aid in designing a treatment program
- Aiding in identification of specific risk factors for stones using a 24-hour urine collection
- Monitoring the effectiveness of therapy by confirming that the crystallization potential has indeed decreased
- Evaluating kidney excretion of acid and urine pH
- Estimating a patient's protein intake

Profile Information

| Test Id | Reporting Name | Available Separately | Always Performed |
|---------|-------------------------------------|----------------------|------------------|
| SSIN1 | Supersaturation, 24 HR,Home Kit,U 1 | No | Yes |
| NAUT | Sodium, 24 HR, U | Yes, (order NAU) | Yes |
| KUT | Potassium, 24 HR, U | Yes, (order KUR) | Yes |
| CALUT | Calcium, 24 HR, U | Yes, (order CALU) | Yes |
| MAGT | Magnesium, 24 HR, U | Yes, (order MAGU) | Yes |
| CLUT | Chloride, 24 HR, U | Yes, (order CLU) | Yes |
| POUT | Phosphorus, 24 HR, U | Yes, (order POU) | Yes |
| SULFT | Sulfate, 24 HR, U | Yes, (order SULFU) | Yes |
| CITT | Citrate Excretion, 24 HR, U | Yes, (order CITR) | Yes |
| OXUT | Oxalate, 24 HR, U | Yes, (order OXU) | Yes |
| UPHT | pH, 24 HR, U | Yes, (order PHU_) | Yes |
| URICT | Uric Acid, 24 HR, U | Yes, (order URCU) | Yes |
| CTUT | Creatinine, 24 HR, U | Yes, (order CTU) | Yes |
| OSMUT | Osmolality, 24 HR, U | Yes, (order UOSMU) | Yes |
| AMMT | Ammonium, 24 HR, U | Yes, (order AMMO) | Yes |
| UNT | Urea Nitrogen, 24 HR, U | No | Yes |
| PCRUT | Protein Catabolic Rate, 24 HR, U | No | Yes |
| DEMO9 | Patient Demographics | No | Yes |

Highlights

Urine specimens for this test are collected by the patient and sent directly to Mayo Clinic Laboratories via supplied collection kit. For more information, see Specimen Required.

Method Name

- AMMT, CITT, OXUT: Enzymatic
- OSMUT: Freezing Point Depression
- SULFT: High-Performance Ion Chromatography (HPIC)
- CALUT, POUT: Photometric
- MAGT: Colorimetric Endpoint Assay
- UPHT: pH Meter
- NAUT, KUT, CLUT: Potentiometric, Indirect Ion-Selective Electrode (ISE)
- CTUT: Enzymatic Colorimetric Assay
- URICT: Uricase
- UNT: Kinetic UV Assay
- [PCRUT, SSIN1: Calculation](#)

NY State Available

Yes

Specimen

Specimen Type

Urine

Necessary Information

1. 24-Hour volume in milliliters is required.
2. Patient's height in centimeters and weight in kilograms are required if patient is younger than 18 years.
3. Patient's street address, city, state, ZIP (postal) code, country, and home phone are required

Specimen Required

Patient Preparation:

- X-ray dyes and contrast media will affect uric acid test results.
- If a kidney X-ray with dye or computerized tomography (CT) scan with contrast has been performed, the patient should wait at least 24 hours before starting collection.
- If a cholangiography (bile duct X-ray) has been performed, the patient should wait 7 days before starting collection.
- If patient has taken tablets for a gallbladder X-ray, the patient should wait 7 days before starting collection.

Supplies: SSH24 Home Collection Kit (T921)

Collection Container/Tube: 24-hour graduated urine container with no metal cap or glued insert

Submission Container/Tube: Plastic, 60-mL urine bottle

Specimen Volume: 35 mL

Collection Instructions:

1. Order test each time the patient is to collect a 24-hour urine specimen at home and mail the specimen directly to

- Mayo Clinic Laboratories.
- Order should be placed a minimum of 3 days prior to desired date of collection.
 - Enter patient's address information for each order created, including street address, city, state abbreviation, zip code, country, and home phone number.
 - For each order, the SSH24 Home Collection kit will be mailed directly to the patient for self-collection. This kit contains instructions for how to properly collect and transport the specimen after collection.

Specimen Minimum Volume

10 mL

Reject Due To

| | |
|--------------------|--------|
| pH <4.5 or pH >8.0 | Reject |
|--------------------|--------|

Specimen Stability Information

| Specimen Type | Temperature | Time | Special Container |
|---------------|--------------------------|----------|-------------------|
| Urine | Refrigerated (preferred) | 14 days | |
| | Ambient | 72 hours | |
| | Frozen | 14 days | |

Clinical & Interpretive

Clinical Information

Urine is often supersaturated, which favors precipitation of several crystalline phases, such as calcium oxalate, calcium phosphate, and uric acid. However, crystals do not always form in supersaturated urine because supersaturation is balanced by crystallization inhibitors that are present in the urine. Urinary inhibitors include ions (eg, citrate) and macromolecules but remain poorly understood.

Urine supersaturation is calculated by measuring the concentration of all the ions that can interact (potassium, calcium, phosphorus, oxalate, uric acid, citrate, magnesium, sodium, chloride, sulfate, and pH). Once the concentrations of all the relevant urinary ions are known, a computer program can calculate the theoretical supersaturation with respect to the important crystalline phases (eg, calcium oxalate).(1)

Since the supersaturation of urine has been shown to correlate with stone type,(2) therapy is often targeted towards decreasing the urinary supersaturations identified. Treatment strategies include alterations in diet and fluid intake as well as drug therapy; all designed to decrease the urine supersaturation.

Reference Values

SUPERSATURATION REFERENCE MEANS (Delta G: DG)

Men:

Calcium oxalate: 1.89 DG

Brushite: 0.46 DG
Hydroxyapatite: 4.19 DG
Uric acid: 1.18 DG

Women:
Calcium oxalate: 1.59 DG
Brushite: -0.11 DG
Hydroxyapatite: 3.62 DG
Uric acid: 0.89 DG

OSMOLALITY, 24 HOUR, URINE
0-11 months: 50-750 mOsm/kg
> or =12 months: 150-1,150 mOsm/kg

pH, 24 HR, U
4.5-8.0

SODIUM, 24 HOUR, URINE
> or =18 years: 22-328 mmol/24 h
Reference values have not been established for patients who are younger than 18 years.

POTASSIUM, 24 HOUR, URINE
> or =18 years: 16-105 mmol/24 h
Reference values have not been established for patients who are younger than 18 years.

CALCIUM, 24 HOUR, URINE
Males: <250 mg/24 h
Females: <200 mg/24 h
Reference values have not been established for patients who are younger than 18 years.

MAGNESIUM, 24 HOUR URINE
> or =18 years: 51-269 mg/24 h
Reference values have not been established for patients who are younger than 18 years.

CHLORIDE, 24 HOUR URINE
> or =18 years: 34-286 mmol/24 h
Reference values have not been established for patients who are younger than 18 years.

PHOSPHORUS, 24 HOUR, URINE
> or =18 years: 226-1,797 mg/24 h
Reference values have not been established for patients who are younger than 18 years of.

SULFATE, 24 HOUR, URINE
7-47 mmol/24 h

CITRATE EXCRETION, 24 HOUR, URINE

0-19 years: Not established
20 years: 150-1,191 mg/24 h
21 years: 157-1,191 mg/24 h
22 years: 164-1,191 mg/24 h
23 years: 171-1,191 mg/24 h
24 years: 178-1,191 mg/24 h
25 years: 186-1,191 mg/24 h
26 years: 193-1,191 mg/24 h
27 years: 200-1,191 mg/24 h
28 years: 207-1,191 mg/24 h
29 years: 214-1,191 mg/24 h
30 years: 221-1,191 mg/24 h
31 years: 228-1,191 mg/24 h
32 years: 235-1,191 mg/24 h
33 years: 242-1,191 mg/24 h
34 years: 250-1,191 mg/24 h
35 years: 257-1,191 mg/24 h
36 years: 264-1,191 mg/24 h
37 years: 271-1,191 mg/24 h
38 years: 278-1,191 mg/24 h
39 years: 285-1,191 mg/24 h
40 years: 292-1,191 mg/24 h
41 years: 299-1,191 mg/24 h
42 years: 306-1,191 mg/24 h
43 years: 314-1,191 mg/24 h
44 years: 321-1,191 mg/24 h
45 years: 328-1,191 mg/24 h
46 years: 335-1,191 mg/24 h
47 years: 342-1,191 mg/24 h
48 years: 349-1,191 mg/24 h
49 years: 356-1,191 mg/24 h
50 years: 363-1,191 mg/24 h
51 years: 370-1,191 mg/24 h
52 years: 378-1,191 mg/24 h
53 years: 385-1,191 mg/24 h
54 years: 392-1,191 mg/24 h
55 years: 399-1,191 mg/24 h
56 years: 406-1,191 mg/24 h
57 years: 413-1,191 mg/24 h
58 years: 420-1,191 mg/24 h
59 years: 427-1,191 mg/24 h
60 years: 434-1,191 mg/24 h

>60 years: Not established

OXALATE, 24 HOUR, URINE

0.11-0.46 mmol/24 h

9.7-40.5 mg/24 h

URIC ACID, 24 HOUR, URINE

Male: > or =18 years: 200-1,000 mg/24 h

Female: > or =18 years: 250-750 mg/24 h

Reference values have not been established for patients who are younger than 18 years.

CREATININE, 24 HOUR, URINE

Male: > or =18 years: 930-2,955 mg/24 h

Female: > or =18 years: 603-1,783 mg/24 h

Reference values have not been established for patients who are younger than 18 years.

AMMONIUM, 24 HOUR, URINE

15-56 mmol/24 h

Reference values have not been established for patients who are younger than 18 years or older than 77 years.

UREA NITROGEN, 24 HOUR, URINE

> or =18 years: 7-42 g/24 h

Reference values have not been established for patients who are younger than 18 years.

PROTEIN CATABOLIC RATE, 24 HOUR, URINE

56-125 g/24 h

Interpretation

Delta G (DG), the Gibbs free energy of transfer from a supersaturated to a saturated solution, is negative for undersaturated solutions and positive for supersaturated solutions. In most cases, the supersaturation levels are slightly positive, even in normal individuals, but are balanced by an inhibitor activity.

While the DG of urine is often positive, even in the urine of non-stone formers, on average, the DG is more positive in those individuals who do form kidney stones. The reference values were derived by comparing urinary DG values for the important stone-forming crystalline phases between a population of stone formers and a population of non-stone formers. DG values that are outside the expected range in a population of non-stone formers are marked abnormal.

If the urine citrate is low, secondary causes should be excluded including hypokalemia, renal tubular acidosis, gastrointestinal bicarbonate losses (eg, diarrhea or malabsorption), or an exogenous acid load (eg, excessive consumption of meat protein).

A normal or increased citrate value suggests that potassium citrate may be a less effective choice for treatment of a patient with calcium oxalate or calcium phosphate stones.

An increased urinary oxalate value may prompt a search for genetic abnormalities of oxalate production (ie, primary hyperoxaluria). Secondary hyperoxaluria can result from diverse gastrointestinal disorders that result in malabsorption. Milder hyperoxaluria could result from excess dietary oxalate consumption or reduced calcium (dairy) intake, perhaps even in the absence of gastrointestinal disease.

High urine ammonium and low urinary pH suggest ongoing gastrointestinal losses. Such patients are at risk of uric acid and calcium oxalate stones.

Low urine ammonium and high urine pH suggest renal tubular acidosis. Such patients are at risk of calcium phosphate stones.

Patients with calcium oxalate and calcium phosphate stones are often treated with citrate to raise the urine citrate (a natural inhibitor of calcium oxalate and calcium phosphate crystal growth). However, since citrate is metabolized to bicarbonate (a base), this drug can also increase the urine pH. If the urine pH gets too high with citrate treatment, one may unintentionally increase the risk of calcium phosphate stones. Monitoring the urine ammonium concentration is one way to titrate the citrate dose and avoid this problem. A good starting citrate dose is about one-half of the urine ammonium excretion (in mEq of each). One can monitor the effect of this dose on urine ammonium, citrate, and pH values and adjust the citrate dose based upon the response. A fall in urine ammonium levels should indicate whether the current citrate is enough to partially (but not completely) counteract the daily acid load of that given patient.

The protein catabolic rate is calculated from urine urea. Under routine conditions, the required protein intake is often estimated as 0.8 g/ kg body weight.

The results can be used to determine the likely effect of a therapeutic intervention on stone-forming risk. For example, taking oral potassium citrate will raise the urinary citrate excretion, which should reduce calcium phosphate supersaturation (by reducing free ionic calcium), but citrate administration also increases urinary pH (because it represents an alkali load), which promotes calcium phosphate crystallization. The net result of this or any therapeutic manipulation could be assessed by collecting a 24-hour urine and comparing the supersaturation calculation for calcium phosphate before and after therapy.

Important stone-specific factors:

- Calcium oxalate stones: urine volume, calcium, oxalate, citrate, and uric acid excretion are all risk factors that are possible targets for therapeutic intervention.
- Calcium phosphate stones (apatite or brushite): urinary volume, calcium, pH, and citrate significantly influence the supersaturation of calcium phosphate. Of note, a urine pH below 6 may help reduce the tendency for these stones to form.
- Uric acid stones: urine pH, volume, and uric acid excretion levels influence the supersaturation. Urine pH is especially critical, in that uric acid is unlikely to crystallize if the pH is above 6.
- Sodium urate stones: alkaline pH and high uric acid excretion promote stone formation.

A low urine volume is a universal risk factor for all types of kidney stones.

Cautions

Urine is often supersaturated with respect to the common crystalline constituents of stones, even in non-stone formers.

Individual interpretation of the supersaturation values in light of the clinical situation is critical. In particular, treatment may reduce the supersaturation with respect to one crystal type but increase the supersaturation with respect to another. Therefore, the specific goals of treatment must be considered when interpreting the test results.

Clinical Reference

1. Werness PG, Brown CM, Smith LH, Finlayson B. EQUIL2: a BASIC computer program for the calculation of urinary saturation. J Urol. 1985;134(6):1242-1244
2. Parks JH, Coward M, Coe FL. Correspondence between stone composition and urine supersaturation in nephrolithiasis. Kidney Int. 1997;51(3):894-900
3. Finlayson B. Calcium stones: Some physical and clinical aspects. In: David DS, ed. Calcium Metabolism in Renal Failure and Nephrolithiasis. John Wiley and Sons; 1977:337-382
4. Burtis CA, Bruns DE. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics. 7th ed. Saunders, 2014
5. Tiselius HG, Daudon M, Thomas K, Seitz C. Metabolic work-up of patients with urolithiasis: indications and diagnostic algorithm. Eur Urol Focus. 2017;3(1):62-71. doi: 10.1016/j.euf.2017.03.014

Performance**Method Description**

The major analytes evaluated are potassium, calcium, phosphorus, oxalate, uric acid, citrate, magnesium, sodium, chloride, sulfate, ammonium, urea nitrogen and pH. The protein catabolic rate is calculated from urine urea nitrogen using the formula: Protein catabolic rate (g/day) = [(UUN+4)* 6.25] g

Given the measured urine concentrations of these analytes and the known affinity constants of the ions for each other at the given pH, a computer program (EQUIL2) calculates a supersaturation for each ion pair of interest (eg, calcium oxalate). Results are expressed as a Delta G (DG) value for each ion pair. DG is the Gibbs free energy of transfer from a supersaturated to a saturated solution.(Werness PG, Brown CM, Smith LH, Finlayson B. EQUIL2: a BASIC computer program for the calculation of urinary saturation. J Urol. 1985;134(6):1242-1244; Moreira DM, Friedlander JI, Hartman C, Elsamra SE, Smith AD, Okeke Z. Using 24-hour urinalysis to predict stone type. J Urol. 2013;190(6):2106-2111)

PDF Report

Supplemental

Day(s) Performed

Monday through Sunday

Report Available

2 to 5 days

Performing Laboratory Location

Mayo Clinic Laboratories - Rochester Main Campus

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

- 82340-Calcium
- 82436-Chloride
- 82507-Citrate excretion
- 82570-Creatinine
- 83735-Magnesium
- 83935-Osmolality
- 83945-Oxalate
- 83986-pH
- 84105-Phosphorus
- 84133-Potassium
- 84300-Sodium
- 84392-Sulfate
- 84560-Uric acid
- 82140-Ammonium
- 84540-Urea Nitrogen

LOINC® Information

| Test ID | Test Order Name | Order LOINC® Value |
|---------|-------------------------------------|--------------------|
| SSH24 | Supersaturation, 24 HR, Home Kit, U | 81232-1 |

| Result ID | Test Result Name | Result LOINC® Value |
|-----------|--------------------------------|---------------------|
| CRU24 | Creatinine, 24 HR, U | 2162-6 |
| AMU24 | Ammonium, 24 HR, U | 25308-8 |
| CAU24 | Calcium, 24 HR, U | 6874-2 |
| CIT24 | Citrate Excretion, 24 HR, U | 6687-8 |
| OXM24 | Oxalate, 24 HR, U (mmol/24 HR) | 14862-7 |
| OXG24 | Oxalate, 24 HR, U (mg/24 HR) | 2701-1 |
| CLU24 | Chloride, 24 HR, U | 2079-2 |
| BSA1 | Patient Surface Area | 8277-6 |
| HT6 | Height (cm) | 3137-7 |

| | | |
|--------|----------------------------------|-----------------|
| WT6 | Weight (kg) | 29463-7 |
| KU24 | Potassium, 24 HR, U | 2829-0 |
| MGU24 | Magnesium, 24 HR, U | 24447-5 |
| NAU24 | Sodium, 24 HR, U | 2956-1 |
| UOSMT | Osmolality, 24 HR, U | 2694-8 |
| PCRUT | Protein Catabolic Rate, 24 HR, U | 93746-6 |
| POU24 | Phosphorus, 24 HR, U | 2779-7 |
| SUL24 | Sulfate, 24 HR, U | 26889-6 |
| UNU24 | Urea Nitrogen, 24 HR, U | 3096-5 |
| UPHT | pH, 24 HR, U | 27378-9 |
| URC24 | Uric Acid, 24 HR, U | 3087-4 |
| 21060 | Interpretation | 69051-1 |
| 616217 | Calcium Oxalate Crystal | 81623-1 |
| 616218 | Brushite Crystal | 101825-8 |
| 616219 | Hydroxyapatite Crystal | 81622-3 |
| 616220 | Uric Acid Crystal | 101827-4 |
| SSDUR | Collection Duration | 13362-9 |
| SSVOL | Volume | 3167-4 |
| CS001 | Patient Street Address | No LOINC Needed |
| CS002 | Patient City | No LOINC Needed |
| CS003 | Patient State | No LOINC Needed |
| CS004 | Patient Zip Code | No LOINC Needed |
| CS005 | Patient Country | No LOINC Needed |
| CS006 | Patient Home Phone | No LOINC Needed |