



Modern Urine Chemistry— The Clinical Significance of Urine Test Results

Answers for life.

SIEMENS

One Simple Test, a Wealth of Information

Urinalysis is a fast, simple, inexpensive, and reliable tool for ruling in, or ruling out, many diseases related to carbohydrate metabolism, urinary tract health, kidney and liver function, acid-base balance, and many other medical conditions.^{1,2}

Clinically relevant information can be obtained when analyzing the combined results of certain test parameters available on the urinalysis test strips. As with all laboratory tests, definitive diagnostic or therapeutic decisions should not be based on any single result or method.



Urinalysis testing

Diabetes

Persons at Risk

- Persons with:
 - Family history of diabetes
 - Obesity
 - High blood pressure
 - Coronary artery disease
 - History of gestational diabetes
 - Chronic pancreatitis
 - Hepatic disorders
 - Cystic fibrosis
- Chronic use of medications such as:
 - high-dose glucocorticoids, chemotherapy agents (L-asparaginase), antipsychotics, and mood stabilizers (phenothiazines)
- High risk ethnicity:
 - Hispanic (Latin American), American Indian, African American, Pacific Islander, and South Asian ancestry

Symptoms

Type 1:

- Excessive urination
- Excessive thirst
- Unexplained weight loss

Type 2:

- Excessive urination
- Excessive thirst
- Fatigue
- Leg or foot pain
- Tingling or numbness in hands/feet
- Ketoacidosis
- Hyperglycemia
- Dehydration
- Sudden vision changes
- Extreme hunger
- Dry skin
- Slow-healing sores
- Frequent infections

Important Tests

Leukocyte – Detects leukocyte esterase found in white blood cells

Nitrite – Detects nitrate-reducing (usually gram-negative) bacteria

Ketones – May detect early ketoacidosis in confirmed diabetics

Glucose – May detect unsuspected diabetes

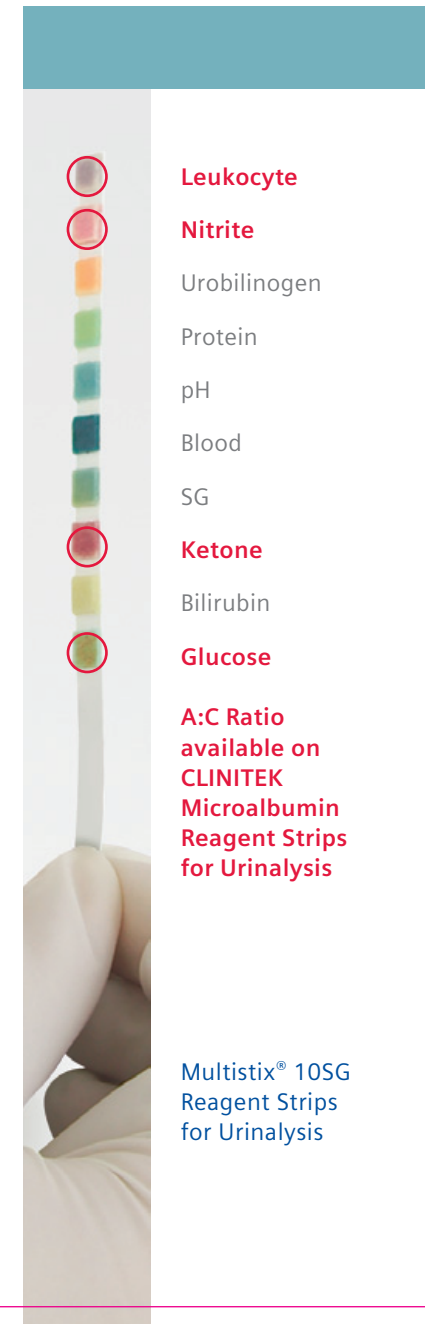
A:C Ratio (Microalbuminuria)* – May detect early kidney damage associated with diabetes ([available on CLINITEK® Microalbumin Reagent Strips for Urinalysis](#))

These tests provide useful information regarding diabetes when performing a routine examination and/or managing people with confirmed diabetes.

The nitrite and leukocyte tests help detect urinary tract infections, which are relatively common complications of diabetes.

The ketone test helps assess the severity of diabetes and avoid progressive diabetic ketosis, which can eventually lead to coma and even death.

*NOTE: The American Diabetes Association recommends the annual measurement of microalbuminuria in all people with type 2 diabetes, and in people with type 1 diabetes with at least 5 years disease duration to aid in the early detection of kidney disease. A flow chart provided by the American Diabetes Association can be used as a guide to microalbuminuria testing.



Eating Disorders

Persons at Risk

Anorexia:

- Teenage girls
- Adult women
- Persons with:
 - Low self-esteem
 - Perfectionistic tendencies
 - Authoritarian parents
 - Family history of eating disorders
- Stress from:
 - Alcohol/drug abuse
 - Stressful home situations
 - Stress related to sports/academic achievement
 - Professions that require thinness: modeling/ballet

Bulimia:

- Persons with:
 - Previous history of being overweight
 - Family history of eating disorders
 - Low self-esteem
 - History of physical, sexual, or relational trauma
- Working or aspiring professions that require thinness: acting, modeling, ballet, or gymnastics

Symptoms

Anorexia:

- Excessive dieting
- Excessive weight loss
- Underweight (85% of normal weight for age/height)
- Intense fear of gaining weight, even if underweight
- Distorted body image
- Menstrual cycle disruption (stopped altogether or missed 3 in a row)
- Overexercises
- Induces vomiting
- Inappropriate use of laxatives or diuretics
- Fainting or severe lightheadedness
- Constipation
- Depression/anxiety

Bulimia:

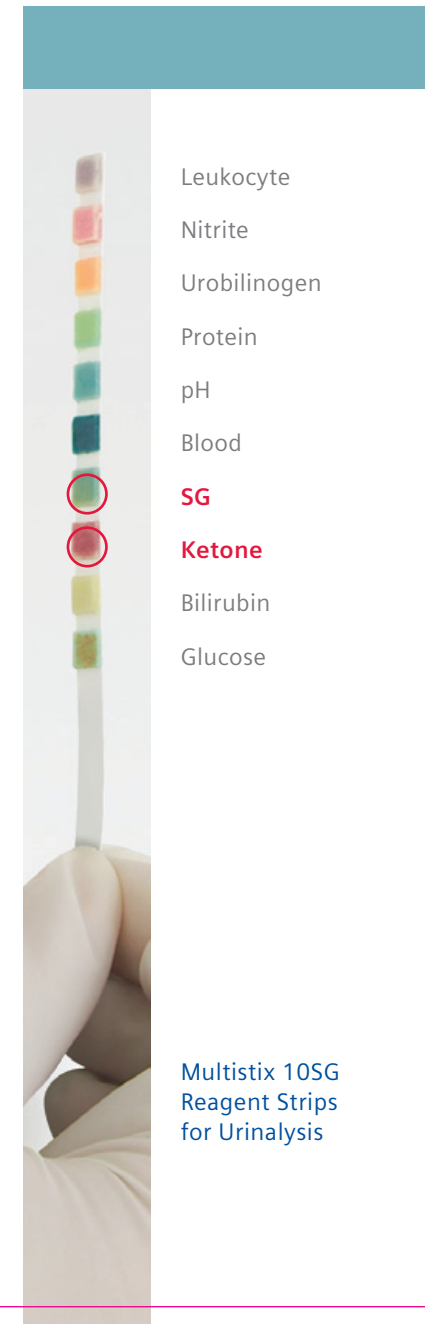
- Binge eating
- Self-induced vomiting
- Inappropriate use of laxatives or diuretics
- Overachieving behavior
- Dental cavities/gingivitis due to excessive vomiting
- Electrolyte imbalance/dehydration

Important Tests

Specific Gravity – A high value may indicate excessive vomiting

Ketones – Detects the presence of ketones in urine that may indicate starvation or vomiting

These tests, when analyzed in combination, provide useful information regarding proper hydration that may be compromised for people diagnosed with eating disorders, such as anorexia nervosa and bulimia nervosa.



Kidney Disorders

Persons at Risk

Kidney Disease:

- Persons with:
 - Family history of kidney disease
 - Diabetes
 - High blood pressure
 - Autoimmune diseases
 - Systemic infections
 - History of urinary tract infections
 - Urinary stones
 - Lower urinary tract obstruction
 - Drug toxicity
- High risk ethnicity: Hispanic (Latin American), African American, Asian, Pacific Islanders, and American Indians
- Elderly

Kidney Stones:

- Persons with:
 - Dehydration
 - Excess amounts of Vitamin C or Vitamin D
 - High protein or sodium diets
 - Sedentary lifestyles
- Medications: Acetazolamide (Diamox) or Indinavir (Crixvan)

Symptoms

Kidney Disease:

- Increased frequency in urination, especially overnight
- Swelling in legs, ankles, feet, face, and/or hands
- Fatigue
- Skin rash/itching
- Metallic taste mouth/ammonia breath
- Nausea/vomiting
- Shortness of breath
- Feeling cold
- Trouble concentrating
- Dizziness
- Leg/flank pain

Kidney Stones:

- Lower back pain radiating to side or groin
- Pain during urination (stinging/burning)
- Blood in the urine (hematuria)
- Increased frequency in urination
- Nausea/vomiting
- Tenderness in the abdomen and kidney region
- Urinary tract infection
- Fever/chills
- Loss of appetite

Important Tests

Leukocyte – Indicates urinary tract infections that can lead to kidney disorders

Protein – Detects the presence of proteinuria which may be caused by kidney malfunction

pH – Used to determine type of kidney stone

Blood – Detects blood in urine which may indicate damage to the kidney

Specific Gravity and/or Creatinine – Provides a relative indication of urine concentration or dilution ([Creatinine available on Multistix PRO®* Reagent Strips for Urinalysis](#))

Protein-to-Creatinine (P:C) Ratio and Albumin-to-Creatinine (A:C) Ratio – Corrects for varying urine concentration, which improves the accuracy of result interpretation, without a timed or 24-hour urine collection ([P:C ratio available on Multistix PRO Reagent Strips for Urinalysis, and A:C ratio available on CLINITEK Microalbumin Reagent Strips for Urinalysis](#))

Ratio Tests:

Measure both protein and creatinine while simultaneously correcting for varying urine concentration.

- Effective for the clinical evaluation of people at risk of developing chronic kidney disease
- Able to be tested in both first morning or random, untimed “spot” urine specimens

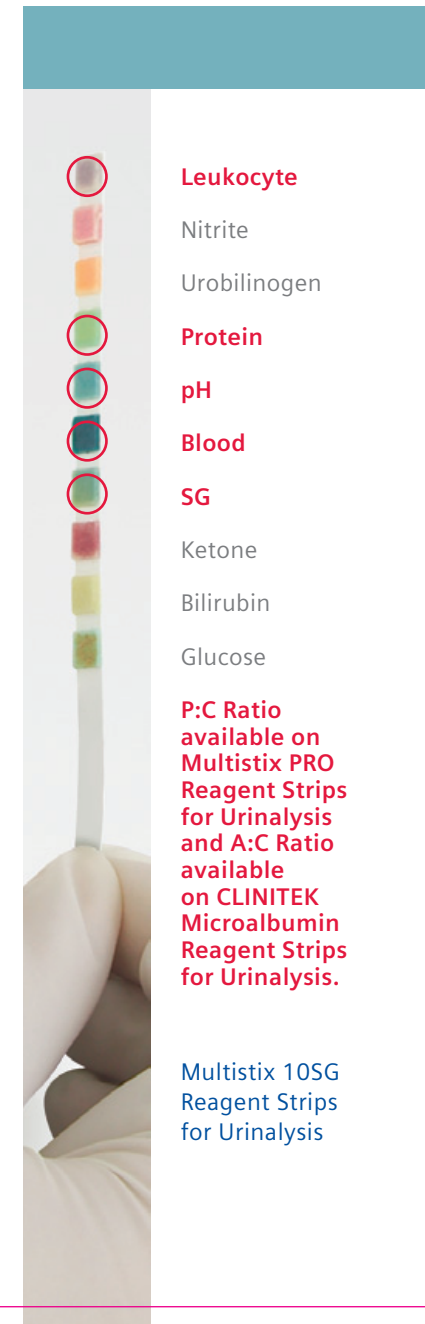
A:C Ratio Tests:

A:C ratio tests are appropriate for testing people with confirmed diabetes. These tests are recognized by the American Diabetes Association for detecting very low level of albuminuria (microalbuminuria).

P:C Ratio Tests:

P:C ratio tests are appropriate for testing the broader population with associated kidney disease risk factors. These tests are recognized by the National Kidney Foundation for detecting higher levels of protein than A:C tests.

*Not available in all markets.



Liver Disease or Damage

Persons at Risk

- Hepatitis A Infected Persons:
 - Exposure to fecal matter
- Hepatitis B Infected Persons:
 - IV drug users
 - Persons having unprotected sex with infected person
- Hepatitis C Infected Persons:
 - Exposure to contaminated needles for IV drug users
 - Persons with tattoos or body piercings
 - Persons having unprotected sex with multiple partners
- Persons with:
 - Excessive alcohol consumption habits
 - Obesity
 - Fatty liver
 - Long-term dialysis

Symptoms

- Jaundice
- Fatigue
- Weakness
- Weight loss
- Poor appetite
- Nausea
- Fever
- Low blood pressure
- Enlarged liver
- Fluid in the abdomen (ascites)
- Feeling of confusion
- Prolonged itching of the skin
- Bright red complexion
- Red palms

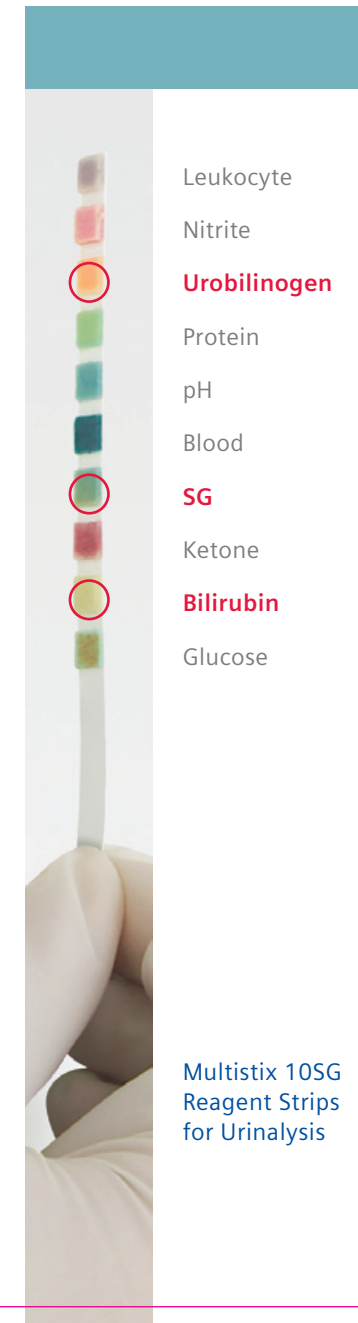
Important Tests

Urobilinogen – Serves as an aid in detecting and differentiating liver disease, hemolytic disease and biliary obstruction

Specific Gravity – Provides a relative indication of whether other tests results are affected by urine concentration or dilution

Bilirubin – May indicate abnormalities affecting the liver or biliary system

Bilirubin and Urobilinogen results, when considered together, provide more helpful information for differential diagnosis than either finding alone.³



Pregnancy Related Disorders

Persons at Risk

Pre-eclampsia:

- First time pregnancy
- Multiple gestations
- Chronic hypertension
- Chronic diabetes
- Kidney disease
- Family history of eclampsia or pre-eclampsia
- Teenagers or women over 40
- High risk ethnicity: Hispanic, African American

Gestational Diabetes:

- Pregnant women
- Diabetic or family history or diabetes
- Past history or gestational diabetes
- High risk ethnicity: Hispanic (Latin American), African American, Native American, Southern or Eastern Asian, Pacific Islander or Indigenous Australian
- Obesity
- Greater than 25 years of age
- Still-birth or large baby with past pregnancy
- Polycystic ovarian disease

Symptoms

Pre-eclampsia:

- High blood pressure
- Swelling (Edema)
- Protein in urine

Gestational Diabetes:

- Increased thirst
- Increased urination
- Weight loss in spite of increased appetite
- Fatigue
- Nausea/vomiting
- Frequent infections including bladder, vaginal and skin
- Blurred vision

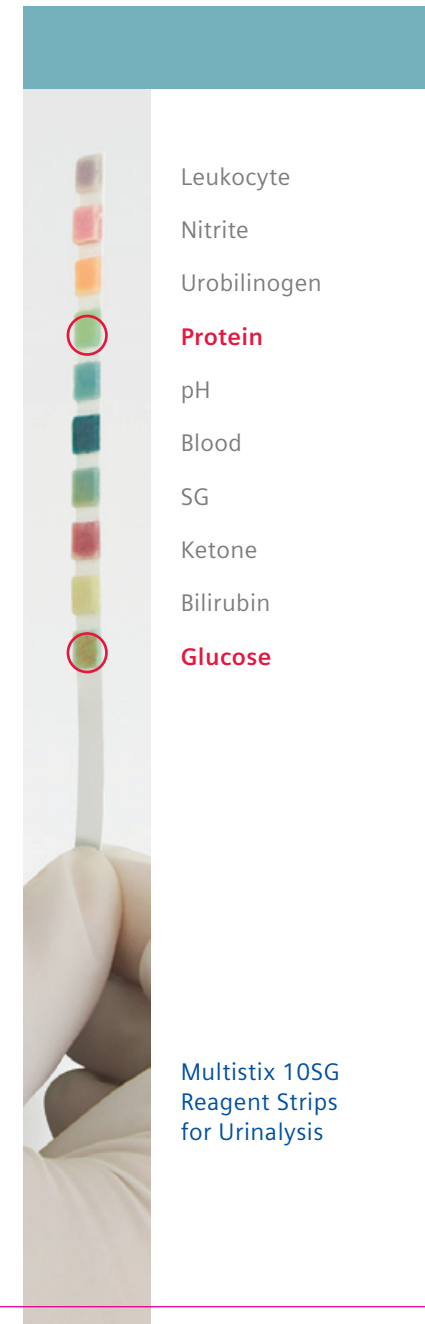
Important Tests

Pre-eclampsia:

Protein – May indicate pre-eclampsia during pregnancy. Urinary protein tests are performed to aid in the diagnosis of pre-eclampsia, a condition of hypertension and proteinuria that occurs in pregnancy and affects about 5–12% of all pregnancies.⁵

Gestational Diabetes:

Glucose – May indicate gestational diabetes. Urinary testing for glucosuria during pregnancy can detect gestational diabetes, which accounts for 88% of all pregnancies with diabetes present.⁴



Sexually Transmitted Diseases (STD)

Persons at Risk

Gonorrhea:

- 15 to 19 year-old women
- 20 to 24 year-old men
- High-density urban areas
- Multiple sex partners
- Unprotected sexual intercourse
- Men having unprotected sex with other men

Syphilis:

- High-risk sexual activity
- Men having unprotected sex with other men
- HIV infected persons
- Previous history of Syphilis

Symptoms

Gonorrhea:

Women:

- Bleeding associated with vaginal intercourse
- Painful or burning sensations during urination
- Yellow or bloody vaginal discharge

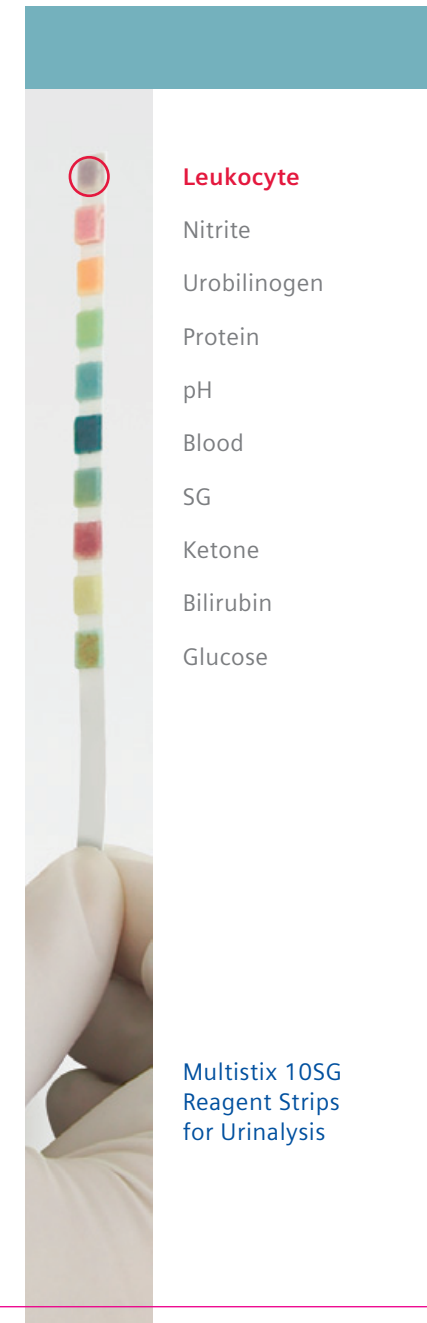
Men:

- White, yellow or green pus from penis with pain
- Burning sensation during urination
- Swollen testicles
- Rectal infection: discharge and itching
- Painful bowel movements
- Fresh blood in feces
- Small, painless sore (chancre) on the part of body where infection is transmitted
- Enlarged lymph nodes in groin
- Skin rash and mucous membrane lesions
- Sore throat
- Patchy hair loss
- General symptoms such as fever, fatigue, loss of appetite, and aches and pains in bones
- Weight loss

Important Tests

Leukocyte – Detects leukocyte esterase found in white blood cells

Elevated test results may indicate detection of bacteria responsible for STDs.



Urinary Disorders

Persons at Risk

Renal:

- Persons with:
 - History of smoking
 - Family history of renal cancer
 - Genetic condition: Hoppel-Lindau disease
- Receiving dialysis

Bladder:

- Persons with:
 - History of smoking
 - Exposure to occupational carcinogens (dye workers, rubber workers, aluminum workers, leather workers, truck drivers, pesticide applicators)
 - Chronic bladder infections
- Women receiving radiation therapy for cervical cancer
- Patients treated with chemotherapy agents: Cyclophosphamide (Cytosan)
- Elderly

Symptoms

Renal:

- Blood in urine (hematuria)
- Abnormal urine color (dark, rusty, or brown)
- Back pain/flank pain
- Abdominal pain/swelling
- Unintentional weight loss
- Enlargement of one testicle
- Vision abnormalities
- Excessive hair growth in females
- Constipation

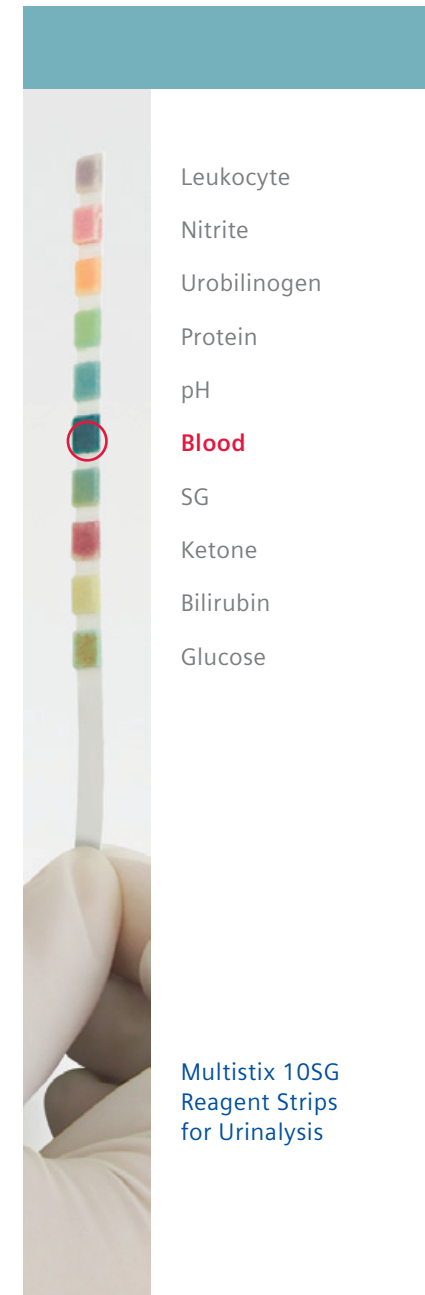
Bladder:

- Blood in urine (hematuria)
- Urinary frequency
- Painful urination
- Urinary urgency
- Urinary incontinence
- Bone pain or tenderness
- Abdominal pain
- Anemia
- Weight loss
- Lethargy (tiredness)

Important Tests

Blood – May indicate damage to the kidney or urinary tract

Although there are many benign reasons for the presence of blood in urine, finding unexpected and unexplained blood in the urine requires follow-up to determine the cause and rule out the presence of cancer.



Urinary Tract Infections (UTI)

Persons at Risk

Women:

- Pregnant Women
- Women with history of UTIs
- Menopausal women not taking estrogen
- Sexually active women

Men:

- Men with Prostatitis
- Men with Benign Prostatic Hyperplasia (BPH)
- HIV infected individuals

Women and Men:

- Catheterized patients
- Persons with kidney stones
- Diabetic persons

Symptoms

- Pain or burning during urination
- Urge for frequent urination
- Lower abdominal pain or heaviness
- Reddish or pinkish urine
- Cloudy urine
- Foul smelling urine
- Back pain just below rib cage (flank pain)
- Fever/chills
- Nausea/vomiting
- Diarrhea in young children

Important Tests

Leukocyte – Detects leukocyte esterase found in white blood cells

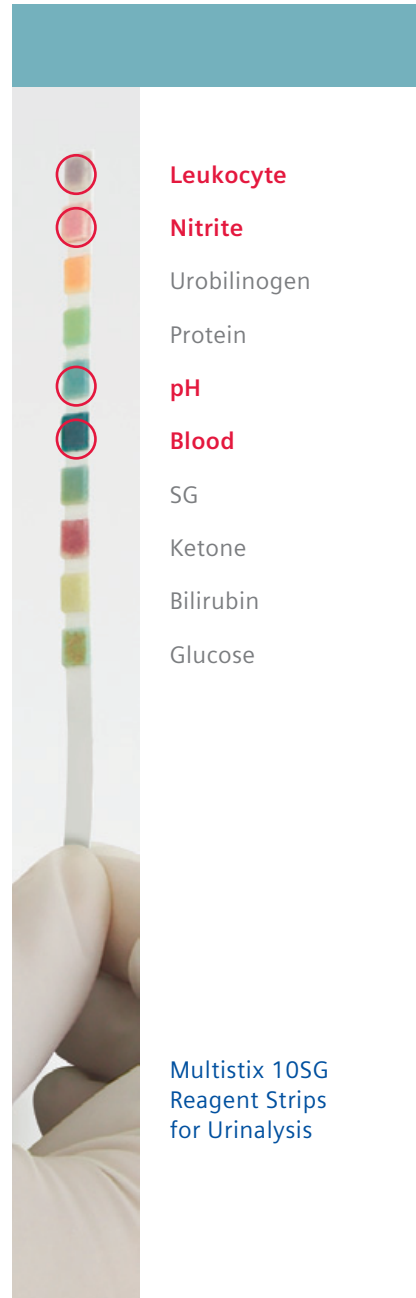
Nitrite – Detects nitrate-reducing, gram-negative bacteria

pH – Typically high or alkaline if UTI is present

Blood – May indicate damage to the urinary tract

In combination, these tests were found to be a better predictor of the presence or absence of UTI, than any one parameter alone.⁶

Urinalysis test strips are an effective “rule-out” tool for patients with suspected UTI. A key advantage of combining the results of leukocyte and nitrite is that if both tests are negative, very few UTIs will be missed.



References

1. Free, A.H. and Free, H.M.: Urinalysis, Critical Discipline of Clinical Science. CRC Crit. Rev. Clinical Lab Science. 1972; 3(4): 481-531
2. Kark, R.M. et. Al: A Primer of Urinalysis, 2nd ed. New York: Harper and Row; 1963.
3. Encyclopedia of Analytical Chemistry, Chichester, UK Vol. 2. 2000; 1714-1723. R.A. Myers (Ed.) John Wiley and Sons LTD.
4. Diabetes Care; V. 18; No. 7; 7/95; 1029.
5. American Journal of Obstetrics and Gynecology; V. 187; No. 3, 9/02; 703.
6. Robertson, AW, Duff P. The nitrite and leukocyte esterase tests for the evaluation of asymptomatic bacteriuria in obstetrics. Obstet. Gynecol 1988; 71:878-881

Additional Information

www.my.webmd.com
www.urologychannel.com
www.lifeoptions.org
www.kidney.org
www.cdc.gov/diabetes
www.diabetes.org
www.nichd.nih.gov
www.familydoctor.org
www.mayoclinic.com
www.nlm.nih.gov

Siemens Healthcare Diagnostics, a global leader in clinical diagnostics, provides healthcare professionals in hospital, reference, and physician office laboratories and point-of-care settings with the vital information required to accurately diagnose, treat, and monitor patients. Our innovative portfolio of performance-driven solutions and personalized customer care combine to streamline workflow, enhance operational efficiency, and support improved patient outcomes.

CLINITEK, Multistix, Multistix PRO, and all associated marks are trademarks of Siemens Healthcare Diagnostics Inc. All other trademarks and brands are the property of their respective owners.

Product availability may vary from country to country and is subject to varying regulatory requirements. Please contact your local representative for availability.

Global Siemens Headquarters

Siemens AG
Wittelsbacherplatz 2
80333 Muenchen
Germany

Global Siemens Healthcare Headquarters

Siemens AG
Healthcare Sector
Henkestrasse 127
91052 Erlangen
Germany
Telephone: +49 9131 84-0
www.siemens.com/healthcare

Global Division

Siemens Healthcare Diagnostics Inc.
511 Benedict Avenue
Tarrytown, NY 10591-5005
USA
www.siemens.com/diagnostics

www.siemens.com/diagnostics