

Urine dipstick analysis

Instructions

- All samples should be midstream and collected in a clean sterile container. Hold the dipstick horizontally before reading.
- The gold standard method of testing is to remove a small volume of urine from the sterile container with a fresh sterile syringe, and then apply the removed urine to the dipstick. In this way, the remainder of the collected sample contents remains untouched by a potentially unsterile dipstick and so can be sent for laboratory analysis if required.

Available urine dipstick tests^[1]

These include:

- Multistix®: suitable for screening for glycosuria only.
- Diastix® testing strips; Medi-Test® Glucose testing strips: detect glycosuria.
- Albustix® testing strips; Medi-Test® Protein 2 testing strips: detect proteinuria.
- Micral-Test II® or Microalbustix®: detect microalbuminuria.
- GlucoRx KetoRx Sticks® 2GK testing strips; Ketostix® testing strips: detect ketonuria.
- Multistix® Reagent strips: can be used to test urine for glucose, ketones, specific gravity, blood, pH, protein, nitrites and leukocytes.
- 10 Parameter Urine Strips: check for leukocytes, nitrite, urobilinogen, protein, pH, blood, specific gravity, ketones, bilirubin and glucose.

Costs vary depending on how many substances can be detected and the supplier.

Physical examination

Colour

The colour of the urine can vary greatly. Normal urine varies from colourless to dark yellow. Various factors can affect urine colour.

Common Causes of Urine Discolouration

Colour	Pathological causes	Food and drug causes
Brown	Bile pigments, myoglobin	Levodopa, metronidazole, nitrofurantoin, some antimalarial agents, fava beans
Brownish-black	Bile pigments, melanin, methaemoglobin	Cascara, levodopa, methyldopa, senna
Green or blue	Pseudomonas urinary tract infection (UTI), biliverdin	Amitriptyline, indigo carmine, IV cimetidine, IV promethazine, methylthioninium chloride, triamterene
Orange	Bile pigments	Phenothiazines, phenazopyridine, rifampicin, hydroxocobalamin
Red	Haematuria, haemoglobinuria, myoglobinuria, porphyria	Beetroot, blackberries, rhubarb, phenolphthalein, rifampicin
Yellow	Concentrated urine (orange to gold in dehydration)	Carrots, cascara

Turbidity

Cloudy urine may be due to:

- Contamination with vaginal mucus or epithelial cells.
- Excess phosphate crystals precipitating in alkaline urine (no clinical significance).
- Pyuria secondary to infection.
- Chyluria (presence of chyle/lymph in the urine - usually secondary to [filariasis](#)).
- Hyperuricosuria secondary to a diet high in purine-rich foods.
- Lipiduria.
- Hyperoxaluria.

One study has recently shown that Gram-negative organisms can be accurately identified directly from an inoculum prepared from centrifuged turbid urine specimens.^[2] This method permits the reporting of the complete results on urine specimens as early as eight hours after their arrival in the laboratory. The most important benefit is the faster pathogen identification and susceptibility data, which allow earlier selective antimicrobial therapy.

Odour

The normal odour is described as urinoid. In concentrated specimens this can be strong but does not imply infection, which has a more pungent smell. Alkaline fermentation causes an ammoniacal smell, and patients with [diabetic ketoacidosis](#) produce a urine that may have a sweet or fruity odour.

Other causes of abnormal odours are cystine decomposition (a sulphuric smell), gastrointestinal-bladder fistulae (a faecal smell), medications (eg, vitamin B6), and diet (eg, asparagus).^[3]

Specific gravity

- Specific gravity (SG) <1.008 is dilute and >1.020 is concentrated.
- Increased SG is seen in conditions causing dehydration, glycosuria, renal artery stenosis, [heart failure](#) (secondary to decreased blood flow to the kidneys), inappropriate antidiuretic hormone secretion and proteinuria.

- Some dipsticks give falsely high readings in the presence of dextran solutions and IV radiopaque dyes, but this varies, so check the manufacturer's leaflet.
- Urine SG may have low specificity in many in some situations. [4]
- Decreased SG is seen in excessive fluid intake, renal failure, [pyelonephritis](#), and central and nephrogenic [diabetes insipidus](#).
- False low readings are associated with alkaline urine (eg, a high-citrate diet).

pH

- The range is 4.5 to 8, but urine is commonly acidic (ie 5.5–6.5) due to metabolic activity.
- Acidic urine (low pH) may be caused by diet (eg, acidic fruits such as cranberries) and uric acid calculi. Spot urine pH by dipstick is not an accurate method for evaluation of the patients with [urolithiasis](#). Patients with alkaline urine are more prone to error with reliance on spot pH. [5]
- Urine pH generally reflects the blood pH but in [renal tubular acidosis](#) (RTA) this is not always the case. If the blood is more acidic than it should be and the urine less acidic than it should be then the possibility of RTA should be considered:
 - In type 1 RTA (distal) the urine and the blood are both acidic.
 - In type 2 (proximal) the urine is initially alkaline but becomes more acidic as the disease progresses.
- Alkaline urine (high pH) is also seen with infection with urease-splitting organisms, and may be associated with the formation of stag-horn calculi.

Haematuria

See also the separate [Haematuria](#) article.

- A positive test indicates either haematuria, haemoglobinuria or myoglobinuria.

- Dipstick tests for the presence of haemoglobin with the degree of colour change directly related to amount present.
- Free haemoglobin or myoglobin causes field change, whereas intact red blood cells (RBCs) are broken down on contact with the reagent pad and release local haemoglobin, producing a dot. These coalesce when >250 RBCs/mL.
- False positive readings are most often due to contamination with menstrual blood; they are also seen with dehydration which concentrates the number of RBCs produced, and exercise.
- False negative readings: captopril, vitamin C, proteinuria, elevated SG, pH less than 5.1 and bacteriuria.
- Dipstick testing for haematuria is the best screening tool.^[6]
- Prognostic significance of a positive test is very controversial – rates ranging from 0.5–6% of patients with a positive test have been found to have underlying significant pathology.

Proteinuria

See also the separate [Proteinuria](#) article.

- Healthy adults normally excrete 80–150 mg protein in urine daily. Normal urinary proteins include serum globulins, albumin, and proteins secreted by the nephron.
- Proteinuria is defined as albumin:creatinine ratio >30 mg/mmol or albumin concentration >200 mg/L. Clinical proteinuria is indicated at greater than 0.5 g of protein per day (greater or equal to 250 mg/L on a test strip). The dipstick test is a widely used screening tool for albuminuria, as a marker for chronic kidney disease, but the albumin:creatinine ratio (ACR) has advantages over the test in sensitivity and quantification of levels.^[7]
- Detectible proteinuria may be the first sign of renovascular, glomerular or tubulo-interstitial renal disease. Alternatively, it may be caused by overflow of abnormal proteins in diseases such as [multiple myeloma](#).

- Most dipstick tests will pick up albumin but may not detect low concentrations of Bence Jones' protein or gamma-globulins. Bence Jones' protein can be detected by a specific antibody test on a midstream sample, whilst urine gamma-globulins can be detected by urine electrophoresis.
- False negatives: alkaline or dilute urine or when primary protein is not albumin.^[8] A more accurate method is to precipitate urinary proteins with 3% sulfosalicylic acid (detects at 2.5 mg/L and detects other proteins). If urine is negative on dipstick but strongly positive with sulfosalicylic acid, suspect multiple myeloma.
- Persistent significant proteinuria detected by dipstick requires further assessment with 24-hour urinary protein excretion, urinary protein:creatinine ratio, microscopic examination of the urinary sediment, urinary protein electrophoresis, and assessment of renal function.
- Microalbuminuria can be detected with Micral-Test II® or Microbumintest® but this should be followed by confirmation in the laboratory, since false positive results are common.

Glucose

See also the separate [Glycosuria](#) article.

- Nearly all glucose filtered by the glomeruli is reabsorbed in the proximal tubules and only undetectable amounts appear in urine in healthy patients. Above the renal threshold (10 mmol/L) glucose will appear in urine. The test relies upon reaction of glucose with glucose oxidase on dipstick to form hydrogen peroxide which causes colour change. This is specific to glucose and no other sugar.
- Useful screen for diabetes mellitus.
- False positive results: seen when high levels of ketones are present. Also seen in patients taking levodopa.
- False negatives: seen where SG is elevated, in uricosuria and in patients taking ascorbic acid.

Ketones

See also the separate [Urine Ketones - Meanings and False Positives](#) article.

- Ketones are not normally found in urine.
- Dipstick tests for the presence of acetoacetic acid at 5-10 mg/dL but not acetone or beta-hydroxybutyric acid. The urine ketone level has been found to be negative in more than half of the patients whose capillary blood ketone level was positive which has implications for the management of diabetic ketoacidosis. [9]
- A positive test is associated with [uncontrolled diabetes](#), pregnancy without diabetes, carbohydrate-free diets and starvation.
- False trace results may be seen in highly pigmented urine and in patients taking levodopa.
- Delay in testing a sample may result in a false negative result.

Bilirubin and urobilinogen

See also the separate [Bilirubinuria](#) article.

- Unconjugated bilirubin is water-insoluble and not normally present in the urine.
- Conjugated bilirubin only appears in urine in the presence of liver disease or obstruction of the bile ducts.
- A small amount of urobilinogen is normally found in urine, but significant amounts suggest that further assessment for haemolytic and hepatocellular disease is indicated.
- Urobilinogen levels can be increased in conditions associated with elevated nitrite levels (eg, UTIs).

Leukocyte esterase and nitrite test

See also the articles on [Urinary Tract Infection in Adults](#) and [Urinary Tract Infection in Children](#).

Important information

Dipsticks become more unreliable with increasing age over 65 years. Up to half of older adults, and most with a urinary catheter, have bacteria in the bladder/urine without an infection (asymptomatic bacteriuria). This causes a positive urine dipstick but is not harmful, and antibiotics are both not beneficial and may cause harm. ^[10]

Nitrites

- This test relies on the breakdown of urinary nitrates to nitrites, which are not found in normal urine.
- Many Gram-negative and some Gram-positive bacteria are capable of producing this reaction and a positive test suggests their presence in significant numbers (ie more than 10,000 per mL). A negative result does not rule out a UTI.
- The reagent is highly sensitive to air exposure, which may cause a false positive response.
- False negative results may be seen where:
 - Bladder incubation time is shortened (less than four hours).
 - There is absence of dietary nitrate.
 - There is presence of nitrate reductase-negative organisms (eg, some mycobacteria strains).
 - Urine SG is elevated.
 - The pH is less than 6.0.
 - There is presence of urobilinogen and urinary vitamin C.

Leukocyte esterase

- This relies on the reaction of leukocyte esterase produced by neutrophils and a positive result suggests pyuria associated with UTI.
- Isolated trace results may be of questionable significance, but repeated ones should not be ignored.

- False positive results may be caused by contamination with vaginal discharge.
- Elevated urine glucose or oxalic acid concentrations may reduce sensitivity, and this may also be seen in patients taking tetracycline or cefalexin.

Efficacy

A negative urine culture can be predicted by negative dipstick test results. Therefore dipstick testing may be a reliable predictor of negative urine culture.^[11] In this study:

- The percentage of positive cultures was 17.5%.
- Nitrite had 28% sensitivity and 99% specificity, with positive and negative predictive values of 89% and 87%, respectively.
- Leukocyte esterase had 79% sensitivity and 84% specificity, with positive and negative predictive values of 51% and 95%, respectively.
- The combination of positive nitrite or positive leukocyte esterase tests had 85% sensitivity and 84% specificity, with positive and negative predictive values of 53% and 96%, respectively.

Further reading

- [Krogsboll LT, Jorgensen KJ, Gotzsche PC](#); Screening with urinary dipsticks for reducing morbidity and mortality. Cochrane Database Syst Rev. 2015 Jan 28;1:CD010007. doi: 10.1002/14651858.CD010007.pub2.
- [Krogsboll LT](#); Guidelines for screening with urinary dipsticks differ substantially – a systematic review. Dan Med J. 2014 Feb;61(2):A4781.

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