THE URINALYSIS – REAGENT STRIPS

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THE URINALYSIS

URINALYSIS REAGENT TEST STRIPS

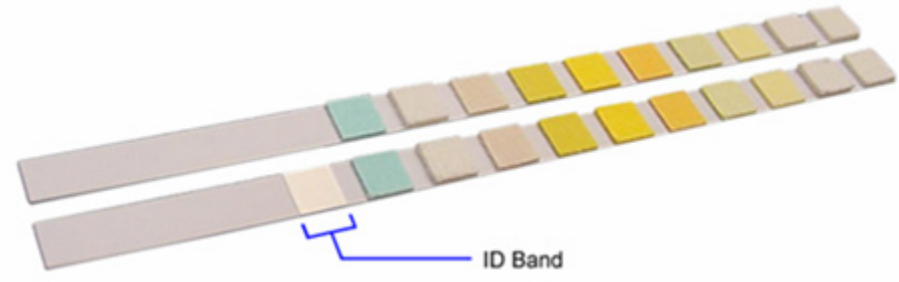
The reagent test strips are important urine screening tests, but there are false negative and false positives as well as many other factors that affect the results. An understanding of the various factors affecting each test is needed to interpret the results and make the results clinically useful.

Reagent strips are plastic strips with pads containing chemicals. The urine reacts with the chemicals to produce a color in the pad and the color correlates with a specific value for each pad. Pads are on the plastic strip for testing glucose, bilirubin, ketones, specific gravity, blood, pH, protein, urobilinogen, nitrite, and leukocytes.

Information and test results may vary depending on which brand of reagent strip used, so become familiar of the specifics of the brand that you use. The package insert would be a good starting point. Multistix and Chemstrip are two common brands.

PRECAUTIONS / PROCEDURES

There are several general procedures and precautions for using reagent strips and testing urine specimens. A midstream clean catch urine is usually satisfactory. A well mixed, uncentrifuged, room temperature urine specimen is used for testing. The urine should be tested within 2 hours (sooner if testing for bilirubin or urobilinogen) or multiple testing errors can result. Refrigeration at 2^0C (35^0F) to 8^0C (46^0F) is the most common way to preserve the urine for testing if there is a delay in testing. Culturing can be done up to 24 hours on refrigerated urine. Refrigeration increases the specific gravity and interferes with urine sediment examination and reagent test strips. Allowing the urine to return to room temperature will allow proper reagent strip testing, better urine sediment examination, and a correct specific gravity. Do not allow run off of urine from one pad to the next pad. Do not read the strip after 2 minutes as color changes are no longer considered accurate. Machines are preferred to read the strip pads, but if reading manually, you must read each pad at the specified time, in a well lighted area, using each brand's specific color chart. Store the reagent strips in the original container with its desiccant. Keep the lid tight on the container. Take reagent strip out only when you are ready to use it. Check the expiration date or the reagent strips. Do not touch the pads with your fingers. **Improperly stored, improperly used, and expired reagent strips will cause inaccurate results**.



Urine Reagent Strips, also called dipsticks, are used to test the urine for various items.

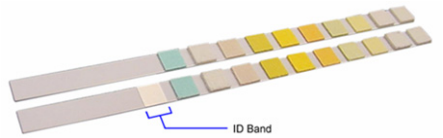
URINE CLARITY OR APPEARANCE

Normal urine is usually clear, but clear urine does not always indicate normal urine.

Causes Of Urine That Is Not Clear

Refrigeration
Urine left standing for hours
Semen in urine
Mucus in urine
Squamous epitheal cells in urine
Radiological contrast media
Contamination (feces, vaginal creams, powders, etc.)
RBCs
WBCs
Bacteria
Yeast
Nonsquamous epithelial cells
Lipids
Crystals
Lymph fluid

URINE PH



There is no "normal" value for urine pH. The value is noted in relationship to the blood's pH, diet, infection, and renal function. The urine pH ranges from 4.6 to 8.0. The first morning urine usually has a pH of 5.0 to 6.0. With a blood pH of 7.4, the urine pH is usually about 6.0.

Urine pH should be acidic with metabolic or respiratory acidosis. Urine pH should be alkaline with metabolic or respiratory alkalosis. If it is not, it indicates:
a.) there is not metabolic or respiratory acidosis/alkalosis, or
b.) a kidney disorder of secretion/reabsorption to regulate acid/base.

<u>ACID URINE (decreased pH)</u>
Diabetes mellitus
Dehydration
Starvation
Respiratory or metabolic acidosis
High protein diet
Mandelamine
Urinary tract infection (E. coli)

<u>ALKALINE URINE (elevated pH)</u>
Renal tubular acidosis
Respiratory or metabolic alkalosis
Old urine specimen
Vegetarian diet
Citrus fruits
Obstructing renal stone
Urinary tract infection with urea splitting organism converting urea to ammonia (proteus)

Reagent Strip Testing Errors

- Old urine specimens (increases the pH).
- Adjacent pad runoff can contaminate another pad and cause erroneous values. If protein (acidic) pad is adjacent to the pH pad, the runoff to the pH pad can cause the pH to be lower (acidic) than the actual value.

HEMATURIA CAUSES (also see Appendix A, page 31)

Glomerular

Involves glomerular disease and urine usually contains protein and RBC casts. Berger's disease is the most common cause.

Renal (nonglomerular)

Hematuria due to disorders of the kidney vascular, tubular and interstitial areas. Includes hematuria due to metabolic disorders. Urine usually also contains protein without RBC casts.

Urologic

Involves stones, infections, and tumors. Urine usually has little to no protein or RBC casts.

Reagent Strips

Intact RBCs are lysed when they come into contact with the non hemolyzed pads and the released hemoglobin forms a speckled pattern on the pad.
The strip has a trace and a moderate pad for non hemolyzed (intact) RBCs.
The strip has a trace, small, moderate, and large pad for hemolyzed (lysed) RBCs.

Reagent Strip Testing Errors

False Positive

- High pH, strong oxidizing agents (hypochlorite bleach), myoglobinuria, exercise, dehydration, semen, menstrual blood contamination, bacterial infection (E. coli).

False Negative

- ascorbic acid (pads have been modified to reduce this error).
- Proteins in urine.
- High specific gravity (crenated RBCs in concentrated urine may not lyse on pad).
- pH < 5.1
- Unmixed specimen (RBCs may settled on the bottom of specimen and missed).
- Formalin, captopril, high concentrations of nitrite.

URINE BILIRUBIN (CONT.)

The diagram, on page 24, explains the following results:

	Urine Bilirubin	Urine Urobilinogen
Hemolytic disease	Negative	Increased
Bile duct obstruction	Increased	Normal
Liver damage	Pos. or Neg.	Increased

Bilirubin is not usually found in urine. Unconjugated bilirubin is water insoluble, attached to albumin, and cannot be filtered by the glomerulus. Conjugated bilirubin is water soluble and can be filtered by the glomerulus. The level of conjugated bilirubin is usually not high enough to result in significant level to appear in the urine. Bilirubin in the urine should raise suspicion of liver disease or biliary obstruction.

Urine Bilirubin

Hepatitis, biliary obstruction (stone, cancer), cirrhosis, liver disease.

Reagent Strip Testing Errors

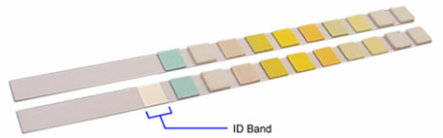
False Positive

- phenazopyridine, pigments, indicans, metabolites of Iodine.

False Negative

- ascorbic acid, high concentration of nitrite, exposure of urine specimen to light, selenium, chlorpromazine.

URINE NITRITE



Nitrate found in the urine normally can be reduced by some bacteria to nitrite. Gram negative bacteria are the major type of bacteria that converts nitrate in the urine to nitrite. The test is either positive or negative for the presence of nitrite. A negative result should not eliminate the possibility of a urinary tract infection. The nitrite test only helps detect urinary tract infections. A urine culture may be indicated by a positive leukocytes esterase test with a positive nitrite test. A positive nitrite test should also have a positive leukocyte esterase test.

Reagent Strip Testing Errors

False Negative:

- Bacteria that do not reduce nitrate will not cause a positive nitrite: (gram positive bacteria, yeast, strep. faecalis, N. gonorrhoeae, M. tuberculosis).
- Bacteria not in bladder urine long enough to reduce nitrate. At least 4 hrs is recommended.
- Lack of diet with adequate nitrate causing lack or urinary nitrate.
- Large amount of bacteria causing nitrite to be converted to nitrogen.
- Ascorbic acid interferes with the reaction.
- Antibiotics.
- Elevated urobilinogen levels.
- High specific gravity.
- pH < 6.0

False Positive:

- Old urine samples (contaminate bacterial growth produces nitrite).
- Pigments in urine.
- Phenazopyridine.
- Improperly stored reagent strips (out of date, container left open, strips left out of container).

CASTS

Hyaline Casts

Glomerulonephritis, pyelonephritis, chronic renal disease, CHF, stress, exercise.

RBC Casts

Glomerulonephritis, exercise, vasculitis, lupus nephritis, sickle cell disease, renal infarct, subacute bacterial endocarditis, malignant hypertension.

WBC Casts

Glomerulonephritis, pyelonephritis, interstitial nephritis, lupus nephritis.

Bacterial Casts

Pyelonephritis.

Epithelial Cell Casts

Renal tubular damage, acute tubular necrosis, eclampsia, ethylene glycol intoxication, heavy metal poisoning, interstitial nephritis.

Granular Casts

Glomerulonephritis, pyelonephritis, stress, exercise.

Waxy Casts

Chronic renal failure, stasis of urine flow.

Fatty Casts

Diabetes mellitus, nephrotic syndrome, hypothyroidism, tubular necrosis, crush injuries, Fabry's disease.

Broad Casts

Renal failure, stasis of urine.

URINE ALBUMIN TO CREATININE RATIO

This is a good monitoring tool of proteinuria without obtaining a 24 hour urine protein collection. The first morning urine voiding is the best specimen.

Urine Protein to Urine Creatinine Ratio $= \dfrac{\textbf{Urine Protein (mg)}}{\textbf{Urine Creatinine (mg)}}$

Normal	< 0.5 (children under age 2 years)	(<0.5 mg protein to 1 mg creatinine)
	< 0.2 (adults and children over age 2 years)	(<0.2 mg protein to 1 mg creatinine)
Abnormal	> 2.0	

Urine Albumin to Urine Creatinine Ratio $= \dfrac{\textbf{Urine Albumin (mg)}}{\textbf{Urine Creatinine (mg)}}$

Normal	General:	< 0.030	(< 30 mg albumin to 1 gram creatinine)
	Men:	< 0.017	(< 17 mg albumin to 1 gram creatinine)
	Women:	<0.025	(< 25 mg albumin to 1 gram creatinine)
Abnormal	Microalbuminuria:	0.030 to 0.30	(30 – 300 mg albumin to 1 gram creatinine)
	Macroalbuminuria:	> 0.30	(>300 mg albumin to 1 gram creatinine)

(Reagent Strip Interference (1 of 2)	FALSE POSITIVE	FALSE NEGATIVE
Antibiotics		NOTE THAT MANY ITEMS ON
Antiseptics		THIS CHART HAVE BEEN
Ascorbic acid		REMOVED IN THIS SAMPLE! Bilirubin, Blood. (pads modified to reduce the blood pad false negative)
Bacteria not in bladder urine long enough to reduce nitrate (at least 4 hrs is recommended) Bacteria that do not reduce nitrate Bacteria, large amount (causing nitrite to be converted to nitrogen)		
Bacterial infection (e.g. E. coli)	Blood.	
Bacteria (gram positive organisms)		Leukocyte esterase.
Blood menstrual contamination		
Captopril	Ketones.	Blood.
Cephalosporins		Leukocyte esterase.
Chlorpromazine	Urobilinogen on Multistix, Bilirubin.	
Dehydration	Blood.	
Dextran solutions	Specific gravity (higher than actual).	
Diet with inadequate nitrate		Nitrite.
Dyes (contrast agents) used in procedures	Ketones, Protein	
Exercise	Blood.	
Formalin	Leukocyte esterase.	Blood; Urobilinogen on Multistix and Chemstrip.
Gentamycin		Leukocyte esterase.
Glucose (high concentration)		
Indicans	Bilirubin.	
Ketones, high levels		Leukocyte esterase, Glucose.
Levodopa		
Light, exposure of urine specimen		
Lodine metabolites		
Methyldopa	Urobilinogen on Multistix.	
Myoglobinuria		
Nephrolithiasis	Leukocyte esterase	
Neutropenia		
Nitrate, high concentration	Bilirubin	Urobilinogen on Chemstrip, Blood.
Nitrofurantoin		
Oxalic acid (e.g. ice tea)		Leukocyte esterase