

# THE URINALYSIS

## LABORATORY TESTING OF URINE

### AND WHAT IT REVEALS



#### CHEMICAL ANALYSIS

pH, protein, glucose, ketones & more



#### MICROSCOPIC EXAMINATION

Cells, casts, crystals, bacteria & more



#### PHYSICAL CHARACTERISTICS

Color, clarity, specific gravity



#### CLINICAL CORRELATION

Accurate results. Better decisions. Improved outcomes.



EVERY SAMPLE.  
EVERY DETAIL.  
EVERY ANSWER.

ALFRED RICKS JR., MD

# **THE URINALYSIS – REAGENT STRIPS**

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# THE URINALYSIS

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## URINALYSIS REAGENT TEST STRIPS

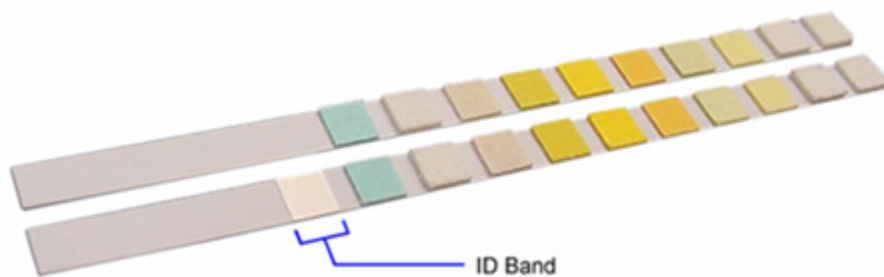
The reagent test strips are important urine screening tests, but there are false negative and false positives as well as many other factors that affect the results. An understanding of the various factors affecting each test is needed to interpret the results and make the results clinically useful.

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.

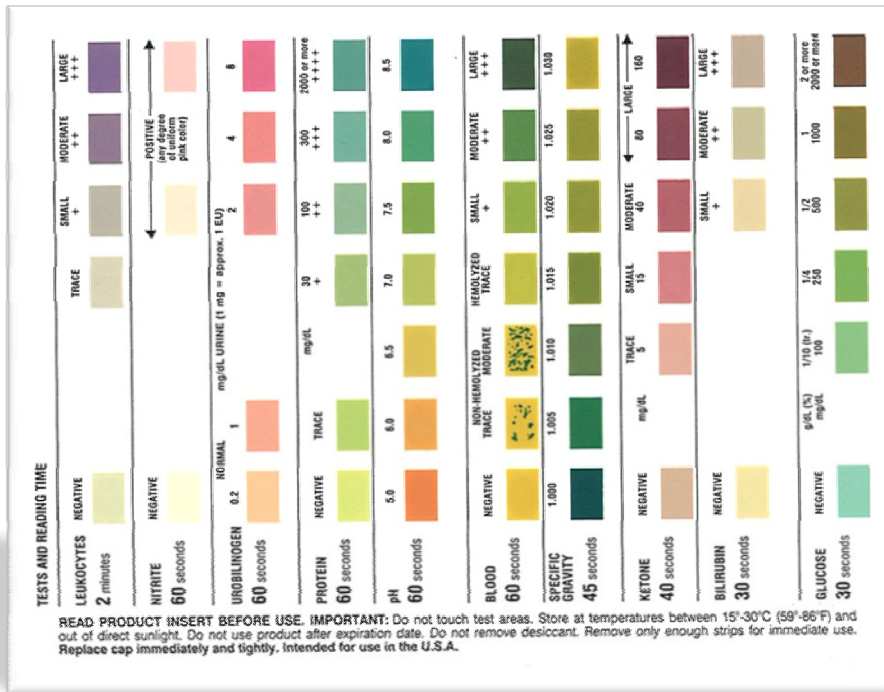
Information and test results may vary depending on which brand of reagent strip used, so become familiar of the specifics of the brand that you use. The package insert would be a good starting point. Multistix and Chemstrip are two common brands.

### 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°C (35°F) to 8°C (46°F) 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.



Sample of a color chart used to determine the color results of the urine reagent strip tests.



A lab machine used to read the reagent test strips. The machine is a much more reliable reader than human reading of the color results.

## RENAL FUNCTION OVERVIEW

The kidneys filter the plasma. This filtrate enters the renal tubules where (a) reabsorption of substances and water in the filtrate back into the body's plasma occurs and (b) secretion of substances from the plasma into the tubular filtrate occurs. The solution that is output is the urine which contains 90-95% water and 5-10% substances.

### Major Organic Substances

Urea (from protein and amino acid breakdown in the liver)

Creatinine (from muscle and diet)

Uric acid (from diet)

### Major Inorganic Substances

Chloride

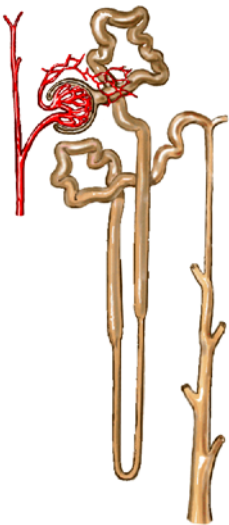
Sodium

Potassium

Urine may also contain medications, vitamins, hormones, enzymes, fatty acids, carbohydrates, ammonium, magnesium, and calcium. Bacteria, casts, cells, and crystals may also be found in the urine.

### Urine Volume

Normal urine volume is influenced by the body's hydration state. Urine volume can be affected by such things as water intake, diabetes, ADH hormone, dehydration, diuretic use, and alcohol use.



The glomeruli filter about 120 mL/min of filtrate from the plasma. This filtrate at the glomerulus has a specific gravity of 1.010. Since we know the specific gravity at this site, we can compare it to the specific gravity at excretion. Obviously, 120 mL of this filtrate with important and required substances cannot be excreted and lost every minute. Renal tubular reabsorption and renal tubular secretion determines the substances in the excretion fluid (urine), the urine volume, and the urine specific gravity.

## GLOMERULAR FILTRATION RATE (GFR)

To determine GFR, a substance that is not reabsorbed or secreted in the tubules is needed for measurement. The most common substance used is creatinine. The creatinine clearance measures the clearance or filtration (the GFR) of the substance creatinine. The creatinine clearance has some variables such as some is secreted, medications can affect the results, and possible improper specimen collection. A 24 hours urine specimen collection is obtained and formulas are used to calculate the creatinine clearance. Normal creatinine clearance is around 120 mL/min, but it is variable for men, women, and body size. The creatinine clearance is not primarily a screening test for early renal disease, but to monitor the status of known renal disease or to determine the dose of medications affected by renal disease. The creatinine clearance involves collecting a 24 hour urine specimen. Due to problems in collecting a urine specimen for 24 hours, measuring urine creatinine, and other variables in measurements, several formulas have been developed to calculate the GFR. Here is one:

$$\text{Creatinine Clearance (C}_{\text{cr}}) = \frac{(140 - \text{age}) (\text{weight in kilograms})}{72 \times \text{serum creatinine in mg/dL}}$$

There are changes and adjustments to this formula for variables to make it more accurate.

Unless you are a kidney specialist, taking an exam, or a nerd, don't spend too much time trying to commit to memory such things as the specific renal tubular reabsorption and secretion sites of glucose, salts, etc. It is best to learn the concepts because the primary concern of this urinalysis review is to use the urinalysis to screen and evaluate your patients. The goal is to look at the urinalysis results, understand the possible meanings of each test result, and find valuable information about our patients. Understanding that the substances in the filtrate are actively and passively reabsorbed or secreted in the renal tubules makes it simple to understand the reasons of the substance appearing in the urine. If you don't know the specific area of the renal tubule, you can still effectively evaluate your patient. The active transport of glucose in the renal tubules stops when the blood glucose level is 160-180 mg/dL. Finding glucose in the urine should make you think of diabetes and expect a blood sugar greater than 160. However, if the blood sugar is normal, it would indicate renal tubular damage.

The concentration of urine depends on the reabsorption of water. This is controlled by antidiuretic hormone (ADH).

increased ADH causes increased reabsorption of water.

decreased ADH causes decreased reabsorption of water.

ADH level normally depends on the body's fluid status

increased body fluid → decreased ADH → increased urine water (volume)

decreased body fluid → increased ADH → decreased urine water (volume)

## **TUBULAR REABSORPTION**

Proximal Convoluted Tubules: Active reabsorption of glucose, salts, and amino acids.

Ascending Loop of Henle: Active reabsorption of chloride.

Passive reabsorption of sodium.

Distal Convoluted Tubules: Active reabsorption of sodium.

Water: Passive reabsorption everywhere except the ascending loop of Henle.

## **TUBULAR SECRETION**

Tubular secretion is the transport of substances in the blood into the renal tubules. It mainly involves:

1.- Acid base regulation by the secretion of hydrogen.

Abnormal secretion of hydrogen ion and chemical reactions regulating this secretion will result in abnormalities in acid base status. When the kidneys cannot make an acid urine, it will cause metabolic acidosis (renal tubular acidosis).

2.- Secretion of substances, medications, and waste products not filtered by the glomerulus.