

## **General Urine Examination**

### **Urine and urinalysis (The Composition of Urine)**

Urinalysis can reveal diseases that have gone unnoticed because they do not produce striking signs or symptoms. Examples include diabetes mellitus, various forms of glomerulonephritis, and chronic urinary tract infections.

**Urine** (from Latin *Urina, ae, f.*) is a liquid by-product of the body secreted by the kidneys through a process called urination (or micturition) and excreted through the urethra. Cellular metabolism generates numerous by-products, many rich in nitrogen that require clearance from the blood stream. These by-products are eventually expelled from the body during urination, the primary method for excreting water-soluble chemicals from the body. These chemicals can be detected and analyzed by urinalysis. Human urine, together with human feces, are collectively referred to as human waste or human excreta.

- ❖ Urine is formed in nephron by three processes of glomerular filtration, tubular reabsorption, and tubular secretion.
- ❖ Any factors that affect the three processes of urine formation will influence components in urine.
- ❖ Various diseases are characterized by abnormal metabolism, which causes abnormal by-products to appear in the urine.
- ❖ An analysis of urine can yield valuable information about the health of the kidney and the body in general.

Sample of human urine



Human urine consists primarily of water, with organic solutes including urea, creatinine, uric acid, and trace amounts of enzymes, carbohydrates, hormones, fatty acids, pigments, and mucus, and inorganic ions such as sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ), chloride ( $\text{Cl}^-$ ), magnesium ( $\text{Mg}^{2+}$ ), calcium ( $\text{Ca}^{2+}$ ), ammonium ( $\text{NH}_4^+$ ), sulfates ( $\text{SO}_4^{2-}$ ), and phosphates (e.g.,  $\text{PO}_4^{3-}$ ). A representative chemical composition would be:

**water** 95%, **urea** 9.3 g/l, **chloride** 1.87 g/l, **sodium** 1.17 g/l, **potassium** 0.750 g/l, **creatinine** 0.670 g/l, with lesser amounts **of other ions and compounds**.

The amount of urine your body produces in a day can be directly related to your health. The kidneys' main function is to maintain the correct balance of water and various chemicals in your blood. If your kidneys aren't functioning properly, an increase or decrease in urinary output could indicate the presence of kidney disease. As of 2013, kidney disease is the eighth leading cause of death in the U.S., according to the Centers for Disease Control and Prevention.

### **Urine Formation**

The kidneys remove waste products from blood and expel them in urine. They accomplish this by filtering blood. Kidneys reabsorb the molecules, nutrients and water body needs and excrete concentrated waste products. When the kidneys aren't functioning properly, waste and fluid that are typically removed from body in the urine can accumulate and cause disease.

### **Normal Urinary Output**

The normal range for an adult urinary output is between 400 to 2,000 mL of urine daily -- with a normal fluid intake of about 2 liters per day. Values for normal urinary output may vary slightly between laboratories. A urine output of 500 mL per day is generally considered adequate for normal function.

Factors other than kidney disease that can influence how much urinate in a day include how much water you consume, the amount of fluid lost in perspiration, caffeine and alcohol intake and any medications you've taken. If doctor is concerned about kidneys, a 24-hour urine collection test is typically ordered.

### **Physical characteristics**

Physical characteristics that can be applied to urine include color, turbidity (transparency), smell (odor), pH (acidity - alkalinity) and density.

**Color:** Typically yellow-amber, but varies according to recent diet and the concentration of the urine. Drinking more water generally tends to reduce the concentration of urine, and therefore causes it to have a lighter color.

**Smell:** The smell of urine may provide health information. For example, urine of diabetics may have a sweet or fruity odor due to the presence of ketones (organic molecules of a particular structure). Generally fresh urine has a mild smell but aged urine has a stronger odor similar to that of ammonia.

**Acidity:** pH is a measure of the acidity (or alkalinity) of a solution. The pH of a substance (solution) is usually represented as a number ranging from 0 (strong acid) to 14 (strong alkali, also known as a "base"). Pure water is "neutral" in the sense that it is neither acid nor alkaline; it therefore has a pH of 7. The real significance of pH in terms of physical chemistry is that it measures the activity of hydrogen ions ( $H^+$ ) in a solution.

The pH of normal urine is generally in the range 4.6 - 8, with a typical average being around 6.0. Much of the variation occurs due to diet. For example, high protein diets result in more acidic urine, but vegetarian diets generally result in more alkaline urine (both within the typical range of 4.6 - 8).

**Density:** Density is also known as "**specific gravity**". This is the ratio of the weight of a volume of a substance compared with the weight of the same volume of distilled water. The density of normal urine ranges from 0.001 to 0.035.

**Turbidity:** The turbidity of the urine sample is gauged subjectively and reported as clear, slightly cloudy, cloudy, opaque or flocculent. Normally, fresh urine is either clear or very slightly cloudy. Excess turbidity results from the presence of suspended particles in the urine, the cause of which can usually be determined by the results of the microscopic urine sediment examination. Common causes of abnormal turbidity include: increased cells (RBC, WBC), numerous crystals, bacteria, lipiduria (lipids often raise to the surface), mucus, semen or fecal contamination.

<b><u>ABNORMAL CONSTITUENT:</u></b>	<b><u>ASSOCIATED CAUSES:</u></b>
<b>Protein (albumin)</b>	Albumin is normally too large to pass through glomerulus. Indicates abnormal increased permeability of the glomerulus membrane. <i>Non-pathological causes are: pregnancy, physical exertion, increased protein consumption. Pathological causes are: glomerulonephritis bacterial toxins, chemical poisons.</i>
<b>Glucose –</b>	Glycosuria is the condition of glucose in urine. Normally the filtered glucose is reabsorbed by the renal tubules and returned to the blood by carrier molecules. If blood glucose levels exceed renal threshold levels, the untransported glucose will spill over into the urine. <i>Main cause: diabetes mellitus</i>
<b>Ketones –</b>	Ketone bodies such as acetoacetic acid, beta-hydroxybutyric acid, and acetone can appear in urine in small amounts. These intermediate by-products are associated with the breakdown of fat. <i>Causes: diabetes mellitus, starvation, diarrhea</i>
<b>Bilirubin –</b>	Bilirubin comes from the breakdown of hemoglobin in red blood cells. The globin portion of hemoglobin is split off and the heme groups of hemoglobin is converted into the pigment bilirubin. Bilirubin is secreted in blood and carried to the liver where it is conjugated with glucuronic acid. Some is secreted in blood and some is excreted in the bile as bile pigments into the small intestines. <i>Causes: liver disorders, cirrhosis, hepatitis, obstruction of bile duct</i>
<b>Urobilinogen –</b>	Bile pigment derived from breakdown of hemoglobin. The majority of this substance is excreted in the stool, but small amounts are reabsorbed into the blood from the intestines and then excreted into the urine. <i>Causes: hemolytic anemias, liver diseases</i>
<b>Hemoglobin –</b>	Hemoglobinuria is the presence of hemoglobin in the urine. <i>Causes: hemolytic anemia, blood transfusion reactions, massive burns, renal disease</i>
<b>Red blood cells –</b>	Hematuria is the presence of intact erythrocytes. Almost always pathological. <i>Causes: kidney stones, tumors, glomerulonephritis, physical trauma</i>
<b>White blood cells</b>	The presence of leukocytes in urine is referred to as pyuria (pus in the urine). <i>Causes: urinary tract infection</i>
<b>Nitrite –</b>	Presence of bacteria. <i>Causes: urinary tract infection</i>

