QUALITY FORENSIC TOXICOLOGY

URINALYSIS INTERPRETATION TABLE

Urinalysis Test	Reference Values	Clinical Implications	Interferences	Potential Follow-up Tests*
Urine pH	Normal: Varies from 4.6 to 8.0 Average: pH 6.0	Acidic (pH<7): UTI (*E.Coli*), metabolic acidosis, diabetic ketosis, diarrhea, fasting, fever Alkaline (pH>7): UTI (*Proteus, Psued.*), tubular acidosis, metabolic acidosis (vomiting), respiratory alkalosis.	Bacterial growth due to prolonged standing. "Alkaline tide" following eating. Low pH after overnight fasting	Bacterial urine culture. Investigate disorders of metabolic or respiratory origin. If pH>9 retest 2nd void.
Specific Gravity (SG)	Normal: 1.010 to 1.025 Dilute: <1.010 to 1.001 (H_20= 1.000) Concentrated: >1.025	Low SG: Diabetes insipidus (w/ large UR Vol.), Glomerular and/or kidney infection, renal damage, sample adulteration. High SG (1.025-1.035): Diabetes mellitus, dehydration, surgical stress, congestive heart failure (CHF), nephrosis	False high SGs: X-ray contrast media (>1.040), elevated amounts of protein, penicillin, dextran False low SGs: Sample adulteration, highly alkaline urine, lithium	Investigate presence of diabetes with blood test. Investigate renal dysfunction, CHF. Collect 2nd void if sample adulterated.
Blood	Normal: *Negative* (0-0.02 mg/dL)	Intact RBCs: UTI, Urinary tract or renal tumors, kidney stones, malignant hypertension, glomerular or kidney infection, trauma, or disease, Lupus, leukemia, low platelet counts, strenuous exercise, heavy smokers. Hemoglobin (free): Hemolytic disease (sickle cell, etc.), kidney infarction, prostate surgery, hemolysis from hypotonic/alkaline urine, febrile intoxication, intravascular coagulation	Drug effects (warfarin, aspirin, etc.), menstrual blood. False positives: myoglobin, prostate infection, bromides, copper, iodides, oxidizing agents. False negatives: High Vitamin C concentrations.	Confirmation of positive with 2nd void. Microscopy with urine culture. FISH testing for cancer. Referral to specialist.
Leukocyte Esterase	Normal: *Negative*	UTI, kidney infection or disease, bladder cancer, Lupus, TB	False positives: Vaginal discharge, histocytes, salicylate toxicity, strenuous exercise. False negatives: Large amounts of glucose, proteins. High SG. Certain drugs (tetracycline).	Microscopy with urine culture. FISH testing for bladder cancer.
Bilirubin	Normal: *Negative* (<0.03 mg free Hb/dL)	Hepatitis, liver diseases caused by infections or toxic agents, cirrhosis, bile duct obstruction, liver or bile duct tumors, sepsis, hyperthyroidism.	False positives: Certain drugs (ex. Chlorpromazine, etodolac, imipramine, methyldopa, phenothiazines). False Negatives: Bilirubin rapidly decomposes with light exposure. High Vitamin C or nitrate concentrations can reduce test sensitivity. Chlorhexidine.	Trace amounts warrant investigation of liver disease. Metabolic liver panel.
Urobilinogen	Normal (Random): 0.1-1 EU/dL Normal (24-hour): 0.5-4.0 EU/dL	Increased levels: Hemolytic and pernicious anemias, pulmonary infarction, excessive bruising, biliary disease, cirrhosis, hepatitis. Decreased levels: Bile duct obstruction or inflammation, pancreatic cancer, suppression of gut flora.	Rapid decomposition from light exposure. Certain drugs that cause duct inflammation or gut flora reduction. Time-of-day fluctuation (peak excretion 12-4PM). Low pH: decreased levels. High pH: increased levels.	Bilirubin test correlation. Retest fresh void. Monitor for anemia and/or GI disorders.

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Urinalysis Test	Reference Values	Clinical Implications	Interferences	Potential Follow-up Tests*
Glucose	Random: *Negative* 24-hour: 1-15 mg/dL Critical value: >1000 mg/dL	Diabetes mellitus, gestational diabetes, endocrine disorders, liver or pancreatic disease, impaired tubular reabsorption, CNS disorders (stroke)	False positives: Peroxide, oxidizing agents, stress, myocardial infarction, post-heavy meal testing, IV glucose. False negatives: High Vitamin C concentration, high ketone concentration, RT instability- glycolysis of glucose.	Blood glucose test. Investigate liver, pancreatic, endocrine, kidney disorders and/or diseases
Ketone (Acetoacetic acid)	Normal: *Negative* (<0.3 mg/dL)	Diabetes mellitus, fasting, high fat diets, prolonged vomiting, diarrhea, fever, anorexia, low carb diet, eclampsia, hyperthyroidism, pregnancy, lactation, renal glycosuria	Test does not detect acetone or Beta-hydroxybutyric acid. False positives: Certain drugs (ex. levodopa, phenothiazines, metformin isopropyl alcohol). False negatives: Prolonged exposure of urine to air.	Continued urine ketone testing (most reliable indicator of acidosis). Blood ketone test. Frequent urine ketone testing for diabetic and/or pregnant patients.
Protein	Normal: *Negative*	Single most important indicator of renal disease. Glomerular damage due to infection, hypertension, diabetes, Lupus. Tubular disease, nephritis, congestive heart failure, lymphoma. Sepsis, trauma, leukemia, blood disorders. Preeclampsia, hyperthyroidism, heart disease, opiate toxicity, sickle cell anemia.	Test is not specific to albumin. Non-albumin proteins will also elicit a positive response. False positives: Strenuous exercise, fever, dehydration, pre-menstruation, high alkaline urine. Some drugs may increase protein concentration ex. aspirin, acetaminophen, opioids, corticosteroids, antibiotics, NSAIDs. False negatives: Protein not always present with renal disease. Low SG.	Microscopy with urine culture. Persistent protein positives warrant quantitative 24 hour urine test.
Nitrite	Normal: *Negative*	Urinary tract infection (Gram negative, ex. *E. Coli*)	False positives: Bilirubin, azo dye metabolites. Bacterial reproduction from sitting at RT. False negatives: Negative results do not indicate absence of bacteria. Ensure a first AM sample to confirm negativity. Low nitrate concentration. Low SG. High Vitamin C concentration. *Strep* and *Staph* do not convert nitrates to nitrites.	Microscopy with urine culture.
Color	Normal: Pale yellow to amber	*Colorless*: large fluid intake, untreated diabetes mellitus and/or insipidus, diuretic consumption, nephritis. *Amber*: concentrated urine, bilirubin (foam when shaken), carrots, UT meds. *Brown/green yellow:* Bilirubin. *Green*: pseudomonal infection, chlorophyll. *Pink/red*: RBCs, hemoglobin, myoglobin, porphyrins. *Brown/black*: Oxidized RBCs, methemoglobin, melanin.	Urobilinogen oxidizes over time resulting in darkening urine. Herbal laxatives, heparin, ibuprofen, methyldopa, phenytoin can tint urine red. Levodopa, quinine, iron salts may darken urine. TCAs may turn urine blue-green. Heparin, pyridines, or warfarin may turn urine orange.	Use in conjunction with other urinalysis tests.
Appearance	Normal: Clear to slightly hazy	UTI, presence of RBCs, WBCs, epithelial cells.	Precipitation of urates, carbonates, or phosphates. Semen or vaginal discharges, feces. Talcum, vaginal creams, contrast media	Use in conjunction with other urinalysis tests.

Source: Fischbach, F., Dunning III, M. *A Manual of Laboratory and Diagnostic Tests*. 9th ed.

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