We are pleased to announce the arrival of the fifth edition of Laboratory Tests and Diagnostic Procedures. The text is completely alphabetical, fully cross-referenced, and indexed. There is no need to know which body system is tested or whether the test uses blood or urine or is diagnostic to locate the test. The best advantage, we believe, is that all the information is complete and contained within one cover. There is no need to waste time referring to multiple texts or flipping between sections to obtain test-specific information. Valuable features include designation of the most common tests used for diseases, conditions, or symptoms (Part One), norms throughout all age-groups, drug and herbal and natural-remedy effects on test results, inclusion of medicolegal implications, panic levels and symptoms and emergency treatment for panic levels, dialysis implications for timing of blood draws or treating high levels, client and family teaching, risks of and contraindications for procedures, and whether informed consent is needed. The content is concise enough for novices and complete enough for seasoned practitioners. It has significant value for both students and practitioners of medical technology, medicine, and nursing and is the kind of reference to use throughout one's career. It is appropriate for the many specialties within the professions, and it includes information from across the life span.

The text is organized into two parts. Part One is designed to help the practitioner confirm a suspected diagnosis or condition. The most common tests or procedures used for the suspected diagnosis are indicated. Items with a • symbol next to them are significant tests for the listed condition. Part Two lists the tests and diagnostic procedures in alphabetical order with normal values; panic-level symptoms and treatment, including whether the substance is dialyzable; usage or conditions in which the values may be abnormal; and a concise description of the test and its significance. This edition also includes expanded information on consent requirements, risks and contraindications, client and family teaching, and the details of the test and client care, as well as integration of the most current scientific literature. Other features include the use of shading in Part Two for ease of use, reduction of blood sample volumes to the minimum amount required (to help avoid iatrogenic anemia), information on whether blood samples can be drawn during hemodialysis, expansion of age-specific norms, and improved quality-assurance information on factors that interfere with results. Finally, a comprehensive, international, up-to-date bibliography of specific resources is included to direct practitioners to additional information.

Other features of this edition include the newest tests in many fields. Cross-referencing of the test and procedure names includes associated acronyms to expedite the location of each. The index now includes a synthesis of diseases, tests, and procedures for the entire book in one place. The format of this text is the product of years of clinical practice and expertise. It has been written by practitioners for practitioners. The invaluable contributions of a large number of clinical experts and their contacts who freely shared the most up-to-date information about the tests, procedures, and medical conditions are a most valued feature.

The purpose of this text is to provide complete information to guide practitioners or students in the clinical care of patients. Applicability of information in a text of this type is relative. Although we have used reliable and current sources in the compilation of the book, variations in laboratory techniques and client conditions must be considered for interpretation. The normal and panic levels listed are not meant to be used as rigid separations of normal and abnormal but rather as guidelines for consideration within the context of individual client conditions and laboratory specifications.

We have provided information regarding procedures that may require separate consent forms, or those beyond the general institutional consent form. Certainly there is much variation among institutions regarding whether a consent form is necessary. At the minimum, oral consent is generally documented. We have provided what is general practice according to the
literature and the experience of our expert contributors across the country. However, we caution that institutional protocols vary and should, of course, be consulted and followed. Regardless of whether formal consent is obtained, it is the responsibility of all health care professionals to educate clients undergoing any test or procedure. Teaching about the test or procedure must be tailored to the client’s and the client’s family’s condition, language, comprehension, anxiety level, clinical goals, and other specific needs.

Most drugs in this text are listed by their generic names. This includes specific tests to determine drug levels in either blood or urine and includes within these tests names of drugs that may interfere with the test results. Generic names have been used to save valuable printed space and to avoid confusion attributable to multiple trade names. We must stress that, in judging possible drug interferences, the clinical evaluation of the client should remain primary in the process of interpreting test values. Clearly it is impractical to discontinue all medications to get a “pure value.” If, however, a drug is known to cause severe interferences with the test results, it is clearly stated, and the drug should be discontinued when possible.

With concern about the transmission of bloodborne pathogens and in view of the content of this text, it is imperative to address the safe handling of specimens. In 1994 (revised 1996), the Centers for Disease Control and Prevention (CDC) published “Standard Precautions,” which include guidelines for isolation precautions in hospitals, designed to prevent the transmission of the hepatitis B virus and the human immunodeficiency virus (HIV). A condensed and current version of these recommendations is provided. Most institutions currently follow these guidelines in some version, and we recommend referral to individual institutional protocol.

Years of research and writing went into the completion of this text. It could not have been done without our many dedicated professional contributors, without the assistance and support of our editor Brian Dennison, and without the support of our families, friends, and professional colleagues. We know that we have acquired much knowledge through the process of writing and editing this book. We believe that the book is a valuable tool for all health care professionals.

Cynthia C. Chernecky
Barbara J. Berger
This book contains two major sections: Part One is a selected alphabetical listing of diseases, conditions, and symptoms that will aid in the diagnosis and monitoring of illnesses. Part Two presents information on laboratory and diagnostic tests in alphabetical order, using a consistent, time-saving format.

PART ONE: DISEASES, CONDITIONS, AND SYMPTOMS
The purpose of this section is to assist practitioners in diagnosing and monitoring the progress of illness or wellness.

Part One is a selected alphabetical listing of diseases, conditions, and symptoms. Under each topic is a list of laboratory and diagnostic tests, also in alphabetical order. It is not expected that all the tests listed would necessarily be required or be abnormal for any one disease, condition, or symptom. Rather, any of the listed tests or a combination of tests would likely be performed to aid, confirm, monitor, or rule out that diagnosis or condition. Where appropriate, the tests and/or procedures considered diagnostic or significant in determining a diagnosis are highlighted with a star.

PART TWO: LABORATORY TESTS AND DIAGNOSTIC PROCEDURES
The purpose of this section is to provide a comprehensive, concise, ready reference of practitioner “need-to-know” information about laboratory tests and diagnostic procedures. Features of this section, in format order, include:
• Alphabetical list of laboratory tests and diagnostic procedures: This saves you time in looking up any test. You will also find combined laboratory profiles listed such as CBC, CMP, and Chemistry Profile.
• Norms are listed for all known age-groups and for all known units (i.e., national and international units). Also included are therapeutic peak and trough norms, toxic and panic levels, as well as associated signs, symptoms, and emergency treatment for overdose when applicable. Tests with toxic and/or panic levels include symptoms and treatment. Treatments listed are generally accepted treatments. The listing of these does not imply that some or all of them should be used. Selection of treatments must be based on the client’s history and condition, as well as the history of the episode.
• Usage states the typical conditions or monitoring for which the diagnostic test or procedure is commonly used (i.e., cardiac catheterization).
• Increased, Decreased or Positive, Negative are categories to describe conditions that cause abnormal laboratory test results. Also listed, in alphabetical order, are medications and herbal and natural remedies that interfere with the laboratory results.
• Description: A concise description of the test or procedure is provided, including interpretation of results and significance for various conditions.
• Professional Considerations include seven types of information:
  1. Consent, risks, and contraindications: Indicate whether a separate special consent form IS or IS NOT required. Where tests or procedures carry significant risks, the risks that should be explained to the client are included in a highlighted alert box. Contraindications are in a list of generally accepted conditions (in a highlighted alert box labeled Risks) in which the test or procedure should not be performed and Relative Contraindications in which the test or procedure should be modified, where applicable.
  2. Preparation: Includes supplies needed, assessment for allergies, unusual scheduling requirements, procedural preparation requirements, such as establishing intravenous access, equipment/medications needed to treat anaphylaxis, and medicolegal handling.
  3. Procedure: Gives step-by-step description of specimen collection or procedural steps, including safety “time out” for correct site or procedure verification, client positioning
and participation, and monitoring required during the procedure. NOTE: For blood samples, mini-volumes (1 to 3 mL) are listed for tests in which special manual tests may be run on smaller volumes for clients in whom blood preservation is essential. For pediatric clients, microtainers may be used, but volumes should equate to those specified in the text (e.g., two 1-mL sized microtainers would be needed for a 2-mL specimen). For clients not at risk for iatrogenic anemia as a result of frequent blood sampling, the quickest turnaround times are achieved with higher volumes, which enable automated testing.

4. Postprocedure care: Provides aftercare instructions regarding specimen handling, site dressing, activity restriction, vital signs, and postsedation monitoring.

5. Client and family teaching: Includes instructions the client or family should be informed about, including precare, procedural care, aftercare, and monitoring, as well as disease-specific information, time frame for test results, and follow-up recommendations.

6. Factors that affect results: Gives quality assurance information about items that will interfere with the accuracy of results, such as improper collection techniques, improper specimen handling, drugs and herbals that cause false-positive or false-negative results, and cross-reactivity of other diseases or conditions.

7. Other data: Provides selected information from current research that may not yet be generalizable but could be helpful in decision-making for individuals or groups of clients; recommendations for confirmatory testing if the results are positive; direction to other tests related to the same diagnosis or condition and known association between tests; and national guideline information and recommendations, when available.
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PART ONE

DISEASES, CONDITIONS, AND SYMPTOMS
Abdominal Aortic Aneurysm
(see Aneurysm, Abdominal aortic; Aneurysm, Cerebral; or Aneurysm, Thoracic aortic)

Abortion, Spontaneous
Alpha-fetoprotein, Blood
Amniotic fluid, Alpha1-fetoprotein, Specimen
Amniotic fluid, Chromosome analysis, Specimen
Amniotic fluid, Erythroblastosis fetalis, Specimen
Chorionic villi sampling, Diagnostic
Complete blood count, Blood
Endometrium, Anaerobic, Culture
Estriol, Serum or 24-hour urine
Glucose tolerance test, Blood
• Histopathology, Specimen
• Human chorionic gonadotropin, Beta-subunit, Serum
• Pregnancy test, Routine, Serum and qualitative urine
• Progesterone, Serum
• Type and crossmatch, Blood

Abscess
Actinomyces, Culture
• Biopsy, Site-specific, Specimen (Anaerobic culture, fungus culture)
• Body fluid (Abscess), Anaerobic, Culture
• Bronchial aspirate, Routine, Culture
• Histopathology, Specimen
• Magnetic resonance imaging, Diagnostic
• Skin, Mycobacterium, Culture
• Sputum, Routine, Culture
• Wound, Culture
• Wound, Fungus, Culture
• Wound, Mycobacterium, Culture

Achlorhydria
Acid perfusion test, Diagnostic
• Gastric analysis, Specimen
• Gastrin, Serum
• Histopathology, Specimen
• Intrinsic factor antibody, Blood
• Pepsinogen I antibody, Blood
• pH, Urine
• Urinalysis, Urine
• Vitamin B12, Serum

Acidosis
(see Metabolic acidosis or Respiratory acidosis)

Acne Vulgaris
Biopsy, Site-specific, Specimen (Anaerobic culture)
• Follicle-stimulating hormone, Serum

Acquired Immune Deficiency Syndrome
• Acquired immune deficiency syndrome evaluation battery, Diagnostic
• Beta2-microglobulin, Blood and 24-hour urine
• Biopsy, Site-specific, Specimen
• Bronchoscopy, Diagnostic
• Cerebrospinal fluid, Routine, Culture and cytology
• Chest radiography, Diagnostic
• Cryptococcal antibody titer, Serum
• Cryptococcal antigen titer, Cerebrospinal fluid, Specimen
• Cryptococcal antigen titer, Serum
• Cryptosporidium diagnostic procedures, Stool
• Cytomegalovirus antibody, Serum
• Diffusing capacity for carbon monoxide, Diagnostic
• Hepatitis B surface antigen, Blood
• Lymphocyte subset enumeration, Blood
• Mantoux skin test, Diagnostic
• Oral mucosal transudate, Specimen
• OraQuick Rapid HIV tests, Specimen
• Pneumocystis immunofluorescent assay, Serum
• Pulmonary function tests, Diagnostic
• Single-photon emission computed tomography, Brain, Diagnostic
• Skin, Mycobacteria, Culture
• T- and B-lymphocyte subset assay, Blood
• Throat culture for Candida albicans, Culture
• Toxoplasmosis serology, Serum

Acromegaly
(see also Hyperpituitarism)
• Alkaline phosphatase, Serum
• Alkaline phosphatase, Isoenzymes, Serum
• Calcium, Total, Serum
• Calcium, Urine
• Computed tomography of the body (Chest, head), Diagnostic
• Glucose, Blood
• Glucose tolerance test, Blood in combination with growth hormone and growth hormone–releasing hormone, Blood
• Hydroxyproline, Total, 24-hour urine
• Insulin-like growth factor-I, Blood
• Magnetic resonance imaging, Diagnostic
Phosphorus, Serum
Single-photon emission computed tomography, Diagnostic

**Actinomycosis**
Acid-fast stain, Nocardia species, Culture
• Actinomyces, Culture
• Biopsy, Site-specific, Specimen (Anaerobic culture, fungus culture, routine culture)
Body fluid (Abscess), Anaerobic, Culture
Bronchial aspirate, Routine, Culture
Bronchial washing, Specimen, Diagnostic
Brushing cytology, Specimen, Diagnostic
Cervical-vaginal cytology, Specimen
Chest radiography, Diagnostic
Complete blood count, Blood
Computed tomography of the body, Diagnostic
Endometrium, Anaerobic, Culture
Foreign body, Routine, Culture
Histopathology, Specimen
Sedimentation rate, Erythrocyte, Blood
Sputum fungus, Specimen
Ultrasonography, Diagnostic (Various sites)
Wound culture

**Acute Myocardial Infarction**
(see Myocardial infarction)

**Acute Respiratory Distress Syndrome**
• Blood gases, Arterial, Blood
• Chest radiography, Diagnostic
Complete blood count, Blood
CO–oximeter profile, Blood
C-reactive protein, Serum or plasma
Culture, Blood
Electrolytes, Plasma or serum
Oximetry, Diagnostic
Prothrombin time and international normalized ratio, Plasma
• Pulmonary artery catheterization, Diagnostic
Sputum culture and sensitivity, Specimen
Urea nitrogen, Plasma or serum

**Addison's Disease**
• ACTH stimulation test, Diagnostic
Alkaline phosphatase, Serum
Alkaline phosphatase, Isoenzymes, Serum
Calcium, Total, Serum
Calcium, Urine
Computed tomography of the body (Abdomen), Diagnostic

**Adenovirus Infection**
• Adenovirus antibody titer, Serum
• Adenovirus immunofluorescence, Diagnostic
Ocular cytology, Specimen
• Viral culture, Specimen

**Adrenalectomy**
• Cortisol, Serum
Magnesium, Serum

**Adult Respiratory Distress Syndrome**
(see Acute respiratory distress syndrome)

**Agranulocytosis**
• Blood culture, Blood
• Bone marrow aspiration analysis, Specimen
• Complete blood count, Blood
Culture, Skin, Specimen
Culture, Urine
• Differential leukocyte count, Peripheral blood

**Ahaaptoglobinemia**
• Haptoglobin, Serum

**AIDS**
(see Acquired immune deficiency syndrome)

**Albright Syndrome**
Alkaline phosphatase, Serum
Blood gases, Arterial, Blood
Bone radiography, Diagnostic
Comprehensive metabolic panel, Blood
Dexamethasone suppression test, Diagnostic
Estradiol, Serum
Follicle-stimulating hormone, Serum
Growth hormone and growth hormone–releasing hormone, Blood
Human chorionic gonadotropin, Beta-subunit, Serum
• Hydroxyproline, Total, 24-hour urine
Luteinizing hormone, Blood
Testosterone, Blood
Thyroid function tests, Blood
PART TWO

LABORATORY TESTS
AND DIAGNOSTIC
PROCEDURES
Abdominal Aorta Ultrasonography (Abdominal Aorta Echogram, Abdominal Aorta Ultrasound)—Diagnostic

Norm. Negative for presence of aneurysm. Normal cross-sectional diameter of adult aorta (maximum internal diameter) varies from 3 cm at the xiphoid to about 1 cm at the bifurcation. Transverse and vertical diameters should be the same. Measurements should be taken at various points down the length of the aorta. Any significant increase in diameter toward the feet (caudally) is abnormal. Ultrasound underestimates the anteroposterior diameter (mean, 2.16 mm) and transverse diameter (mean, 4.29 mm) of the abdominal aorta.

Usage. Localization, measurement, and monitoring of abdominal aortic aneurysm; follow-up evaluation of surgical graft and aortic attachment after surgery for aneurysm; and detection of abdominal aortic atherosclerosis or thrombus. May be indicated in clients with pulsatile abdominal mass, poor circulation of the legs, recent abdominal trauma, and suspected idiopathic aortitis.

Description. Evaluation of the structure, size, and position of the abdominal aorta and branches (celiac trunk and renal, superior mesenteric, and common iliac arteries) by the creation of an oscilloscopic picture from the echoes of high-frequency sound waves passing over the anterior portion of the trunk (acoustic imaging). The time required for the ultrasonic beam to be reflected back to the transducer from differing densities of tissue is converted by a computer to an electrical impulse displayed on an oscilloscopic screen to create a three-dimensional picture of the abdominal aorta and branches. Ultrasonography allows measurement of the luminal diameter of the aorta. A narrowed lumen would indicate atherosclerosis or thrombus, whereas a wider-than-normal lumen with an irregular border may indicate aneurysm. Scattered internal echoes within the aneurysm may indicate an internal clot. A double lumen may indicate a tear in the wall of the abdominal aorta. Surgical grafts from aneurysm repair appear as bright echo reflections.

Professional Considerations

Consent form NOT required.

Preparation
1. This test should be performed before intestinal barium tests or else after the barium is cleared from the system (with allowance of several days for clearance).
2. An enema may be prescribed to be given before the ultrasonogram is taken.
3. The client should wear a gown.
4. Obtain ultrasonic gel or paste.

Procedure
1. Client is positioned supine on a procedure table.
2. The abdomen is covered with conductive gel.
3. A lubricated transducer is passed slowly along the abdomen at 1-cm intervals along the transverse and then longitudinal lines, covering the area between the xiphoid process and the symphysis pubis. If dissection is suspected, real-time techniques can be used more specifically to locate the site.
4. Photographs are taken of the oscilloscopic images.
5. Procedure takes less than 60 minutes.

Postprocedure Care
1. Cleanse skin of ultrasonic gel.

Client and Family Teaching
1. Eat a low-residue diet the day before the ultrasonogram is taken, fast from food and fluids after midnight before the test, and refrain from smoking.
2. Lie as still as possible during the procedure, which is painless and carries no risks.
3. Results are normally available within 24 hours.

Factors That Affect Results
1. Dehydration interferes with adequate contrast between organs and body fluids.
2. Intestinal barium or gas obscures results by preventing proper transmission and deflection of the high-frequency sound waves.
3. The more abdominal fat present, the greater is the attenuation (reduction in sound-wave amplitude and intensity), which interferes with the clarity of the picture.
4. Aorta may be displaced by scoliosis, a retroperitoneal mass, or the para-aortic lymph nodes; in some clients, these anomalies can mimic an aneurysm.

Other Data
1. There is some evidence that aneurysms smaller than 4 cm in diameter may be safely followed by ongoing monitoring and any aneurysm larger than 4 cm in diameter should be considered for surgery.
2. Ultrasound ranks below CAT scan (or CT scan) in its accuracy; however, it surpasses CT in screening.

Abdominal Plain Film
See Flat-Plate Radiography of Abdomen—Diagnostic.

Abdominal Ultrasound
See Abdominal Aorta Ultrasonography—Diagnostic; Gallbladder and Biliary System Ultrasonography—Diagnostic; Liver Ultrasonography—Diagnostic; Obstetric Ultrasonography—Diagnostic; Pancreas Ultrasonography—Diagnostic; and Spleen Ultrasonography—Diagnostic.

Abeta
See Beta-Amyloid Protein—CSF.

ABG
See Blood Gases, Arterial—Blood.

ABI
See Ankle-Brachial Index—Diagnostic.

ABO Group and Rh Type—Blood

Norm. Specific to each individual.

Usage. Blood transfusion therapy, erythroblastosis fetalis, paternity determinations, pregnancy, and preoperatively.

Description. The ABO blood group is the phenotype of a client’s blood resulting from genetic inheritance. The four most common phenotypes are A, B, AB, and O, referring to the type of antigen present on the surface of red blood cells. Rh type refers to whether an Rh antigen is present (Rh positive) or absent (Rh negative) on the surface of a client’s red blood cells. Routine testing usually involves only the Rh0(D) antigen. If an Rh-negative client receives Rh-positive blood, he or she will develop Rh antibodies, and future Rh-positive transfusions may cause a transfusion reaction. In pregnancy, antibodies from an Rh-negative mother may hemolyze fetal erythrocytes in a
Abscess

See Body Fluid—Anaerobic Culture.

ACA

See Antiphospholipid Antibodies—Serum.

Accu-Chek

See Glucose Monitoring Machines—Diagnostic.

ACE

See Angiotensin-Converting Enzyme—Blood.
Acetaminophen—Serum

Norm. 2 months to 10 years (received >60 mg of APAP/kg/day) = 0-23 mg/mL.

<table>
<thead>
<tr>
<th>4 Hours After Last Dose</th>
<th>SI Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapeutic level</td>
<td>10-30 µg/mL</td>
</tr>
<tr>
<td>Toxic level</td>
<td>&gt;150 µg/mL</td>
</tr>
<tr>
<td>Panic level (hepatotoxicity)</td>
<td>&gt;200 µg/mL</td>
</tr>
</tbody>
</table>

APAP, N-acetyl-p-aminophenol.

Overdose Symptoms and Treatment

**Symptoms.** Occur in four stages.
1. Stage I (ingestion to 24 hours): Gastrointestinal irritation, pallor, lethargy, diaphoresis, metabolic acidosis, and coma (cases of massive ingestion with serum concentration >800 µg/mL have been reported, but coma is usually attributed to a coingestant such as alcohol).
2. Stage II (24 to 48 hours): Increased serum hepatic enzymes, right upper quadrant abdominal pain, possible decreased renal function.
3. Stage III (72 to 96 hours): Increased AST, ALT, nausea, vomiting, jaundice, lethargy, confusion, coma, coagulation disorders, possible decreased renal function.
4. Stage IV (4 days to 2 weeks): Clinical symptoms subside; laboratory values return to baseline.

**Treatment**

*NOTE:* Treatment choice(s) depend(s) on client's history and condition and episode history.
1. Establish and maintain adequate airway, respiratory, and circulatory function.
2. If client is obtunded or unconscious, appropriate doses of thiamine, dextrose, and naloxone must be considered.
3. Gastric decontamination: In one study, rapid complete bowel lavage with 4 g of polyethylene glycol electrolyte solution was shown to significantly reduce serum acetaminophen levels. In another study, use of activated charcoal prevented acetaminophen absorption when given within 60 minutes of acetaminophen ingestion. An emetic may be used to induce emesis for recent ingestion, but it must be used with extreme caution. Ondansetron can be used to manage vomiting if acetaminophen ingestion occurred within the previous 8 hours.
4. Oral administration of N-acetylcysteine (Mucomyst by Mead Johnson) for suspected toxic doses (>7.5 g). Mucomyst is most likely to be effective when given within 16 hours after acetaminophen ingestion.
5. Laboratory monitoring: Urine toxicology screen, hepatic profile daily for 3-4 days, BUN, Cr, serum electrolytes, serum acetaminophen concentration level 4 hours after ingestion.
6. Coingestion of other substances that delay gastric emptying is an indication for serial measurement to detect late-rising acetaminophen levels.
7. Chronic alcohol intake enhances acetaminophen hepatotoxicity.
8. Hemodialysis WILL but peritoneal dialysis will NOT remove acetaminophen.

**Usage.** Drug abuse, hepatitis, monitoring for toxicity during acetaminophen therapy, overdose, poisoning, and suicide.

**Description.** Acetaminophen (also known as paracetamol) is a p-aminophenol derivative that has antipyretic (direct action on hypothalamus) and moderate analgesic actions. It is absorbed by the gastrointestinal tract and metabolized by liver microsomes. Half-life is 1 to 4 hours with peak blood levels reached in 30 minutes to 1 hour. Used for headache, fever, and relief of pain in clients who cannot tolerate aspirin or those with peptic ulcers or bleeding disorders. It is the drug of choice (antipyretic/analgesic) in children 13 years of age and younger because of the possible development of Reye’s syndrome associated with aspirin. In adults, ingestion of more than 4 g/day can be hepatotoxic.
Acetone

Professional Considerations

Consent form NOT required.

Preparation

1. Tube: Red topped, red/gray topped, gold topped, or lavender topped.
2. Do NOT draw during hemodialysis.
3. Document times of ingestion and sample collection on lab requisition.

Procedure

1. Draw a 4-mL blood sample.

Postprocedure Care

1. None.

Client and Family Teaching

1. Results are normally available within 24 hours.
2. If overdose is suspected, prepare client and family for necessary supportive treatment described above.
3. If activated charcoal was given for elevated levels, client should drink 4 to 6 glasses of water each day for 2 days to prevent constipation. Activated charcoal will also cause stools to be black for a few days.

Factors That Affect Results

1. Cardiovascular, hepatic, gastrointestinal, or renal dysfunction can alter drug absorption and elimination.
2. Toxic levels of acetaminophen positively interfere with glucose-monitoring machine results.
3. Draw two samples, 4 hours apart, to determine the half-life of acetaminophen.

Other Data

1. Acetaminophen is present in many medicines: Anacin 3, Datril, Liquiprin, Panadol, Panex, paracetamol, Phenaphen, Tempra, and Tylenol.
2. Acetaminophen used with aspirin and caffeine alleviates migraine headache pain.
3. Premedication with acetaminophen does not significantly lower the incidence of nonhemolytic transfusion reactions.
4. Acetaminophen poisoning has been found in nearly 50% of all acute liver failure in the United States.
5. Prothrombin time prolongation may be noted in clients with hepatic failure and paracetamol poisoning.

Acetone

See Ketone Bodies—Blood or Toxicology; Volatiles Group by GLC—Blood or Urine.

Acetone—Urine

Norm. Keto-Diastix or Multistix: Negative. Quantitative 0.3–2.0 mg/dL.

Usage. Differentiation of diabetic coma and insulin shock, evaluation of glucose control in diabetics, preadmission screening, pregnancy, screening for ketoacidosis, and monitoring for occupational exposure to isopropyl alcohol. Increased in ethanol hangover and in ingestion of denatured alcohol.

Description. Acetone is a by-product of fat and fatty acid metabolism that provides a source of cellular energy for cells when glucose stores are exhausted or when glucose is prevented from entering cells because of lack of insulin. Acetone entering the bloodstream is almost completely metabolized in the liver. When acetone is formed at a faster-than-normal rate or is present in the bloodstream in higher than normal levels, it is excreted in the urine.

Professional Considerations

Consent form NOT required.

Preparation

1. Obtain a clean urine container and acetone testing strips or tablets.
2. Client should empty the bladder 30 minutes before specimen collection and then drink a glass of water.
3. For specimens obtained from an indwelling urinary catheter, also obtain a catheter clamp, a sterile 10-mL syringe and needle, and an alcohol wipe.

Procedure

1. Obtain a 20-mL double-voided urine specimen in a clean container.
2. Specimens from catheter: Clamp the catheter tubing for 15 minutes to allow urine to accumulate above the sample port. Cleanse the sample port with an alcohol wipe and allow to dry. Aspirate 20 mL of urine from the sample port, using a sterile syringe and needle. Collect only fresh urine that has accumulated above the sample port. Unclamp the catheter tubing.

3. Dip the Keto-Diastix, Multistix, or other acetone testing material in fresh urine and hold the strip horizontally for 15 seconds.

4. Compare the color of the ketone patch on the strip with the color chart on the container of acetone testing strips.

5. Alternative method using Acetest tablets:
   Place a drop of urine on an Acetest tablet and wait 30 seconds. Compare the color with the Acetest color chart.

Postprocedure Care
1. None.

Client and Family Teaching
1. Results are immediately available.

Factors That Affect Results
1. Fasting or dieting may cause acetone to appear in the urine.
2. Use of acetone tablets that are darkened or expired invalidates results.
3. Drugs that may cause false-positive results include captopril, levodopa, paraldehyde, and phenazopyridine hydrochloride.
4. Gender and ingestion of alcohol may affect the basal levels of urinary acetone.

Other Data
1. Refrigerate the specimen if the test cannot be performed within 1 hour of collection.
2. In one study, ratings on scales of well-being and acute symptoms correlated significantly with the concentration of acetone in urine after acute airborne acetone exposure.
3. See also Ketone, semiquantitative—Urine.

Acetylcholine Receptor Antibody—Serum

Norm. ≤0.03 nmol/L.

Usage. Diagnosis and clinical monitoring of myasthenia gravis, Lambert-Eaton myasthenic syndrome, small cell lung carcinoma.

Description. In clients with myasthenia gravis, this antibody interferes with the binding of acetylcholine to receptor sites on the muscle membrane, thus preventing muscle contraction. Assays for acetylcholine receptor (AchR) antibodies are positive in 85%-90% of clients with acute myasthenia gravis and are replacing the Tensilon test as a diagnostic aid for this condition. However, this assay is less sensitive for Lambert-Eaton myasthenic syndrome diagnosis.

Professional Considerations
Consent form NOT required.

Preparation
1. Tube: Red topped, red/gray topped, or gold topped.
2. List on the laboratory requisition any recent immunosuppressive drug therapy the client received.

Procedure
1. Draw a 2-mL blood sample.

Postprocedure Care
1. None.

Client and Family Teaching
1. Results may not be available for several days.

Factors That Affect Results
1. False-positive results may be caused by D-penicillamine.
2. Decrease in titer may be caused by intravenous immunoglobulin (IVIg) therapy.
3. Clients with orthostatic hypotension may have a seropositive AchR antibody.

Other Data
1. Undetectable titer occurs in 33.4% of clients who have only ocular myasthenia gravis.
2. See also Tensilon test—Diagnostic.

Acetylsalicylic Acid

See Salicylate—Blood.
Acid-Fast Bacteria—Culture and Stain

**Norm.** Negative.

**Usage.** Acquired immune deficiency syndrome (AIDS); suspected *Helicobacter pylori*, intestinal parasites, leprosy, mycobacteriosis, or tuberculosis; and differentiation of tuberculosis from carcinoma and bronchiectasis.

**Description.** *Mycobacterium tuberculosis* is a rod-shaped bacterium that resists decolorizing chemicals after staining, a property termed “acid-fastness.” *M. tuberculosis* is transmitted most commonly by the airborne route to the lungs, where it survives well, causes areas of granulomatous inflammation, and, if not dormant, causes cough, fever, and hemoptysis. The acid-fast bacterium *Mycobacterium avium-intracellulare* is a common cause of infection in clients with AIDS. Culture of sputum is necessary to confirm the diagnosis of tuberculosis and for sensitivity studies for drug therapy. The sensitivity of sputum smears for tuberculosis, however, is only 50%.

**Professional Considerations**
Consent form NOT required.

**Preparation**
1. Obtain three small, sterile containers.
2. See Client and Family Teaching.

**Procedure**
1. Aerosolized therapy before sputum collection may stimulate sputum production and produce a better specimen.
2. When tuberculosis is suspected, collect three daily, early-morning sputum, deep-cough specimens in a sterile container.
3. When leprosy is suspected, obtain smear from nasal scrapings or biopsy from lesions and place in sterile container.

**Postprocedure Care**
1. Provide mouth care.

**Client and Family Teaching**
1. Perform oral hygiene before giving specimens to reduce chances of contamination.
2. Deep coughs are necessary to produce sputum, rather than saliva. To produce the proper specimen, take several breaths in, without fully exhaling each, and then expel sputum with a “cascade cough.”

**Factors That Affect Results**
1. Antituberculous drug therapy may cause negative results because of inhibition of growth of *M. tuberculosis*.
2. A high–carbon dioxide atmosphere for growth may increase the number of positive cultures.
3. Culture medium containing glycerin accelerates growth.

**Other Data**
1. Culture results may take 3–8 weeks.
2. The most prevalent intestinal parasites in cancer clients diagnosed by acid-fast stain are *Entamoeba histolytica/Entamoeba dispar* (8.5%), *Giardia lamblia* (3.1%), *Strongyloides stercoralis* (0.6%), and *Cryptosporidium parvum* (0.3%).

Acid-Fast Stain, Nocardia Species—Culture

**Norm.** Negative.

**Usage.** Aids in diagnosis of Behçet’s disease, mycetoma, *Nocardia brasiliensis*, and nocardiosis of the respiratory tract found in persons with systemic lupus erythematosus and nocardial thyroiditis.

**Description.** *Nocardia* is an aerobic, gram-positive, filamentous branching bacterium that segments into reproductive bacillary fragments. It is weakly acid fast; found outdoors in decayed matter, soil, grass, and straw; and enters the body primarily through
inhalation of contaminated dust. The type
species, *Nocardia asteroides*, and *N. brasiliensis*,
*N. farcinica*, *N. otitidis-caviarum*, *N. nova*,
and *N. transvalensis* cause a variety of diseases
in both normal and immunocompromised
humans and animals. The *N. asteroides* species
causes primary skin lesions, visceral infections
(most commonly abscesses of the lungs,
brain, and subcutaneous tissue), and some-
times disseminated infections in humans.

**Professional Considerations**
Consent form NOT required.

**Preparation**
1. Obtain a sterile scalpel or spatula, or a
sterile needle and syringe, and both
anaerobic and aerobic culture media.

**Procedure**
1. Obtain a scraping from a skin lesion or
an aspirate of an abscess using sterile
technique.
2. Inoculate both aerobic and anaerobic
culture media with the specimen.
3. Aerobic culture media of beef infusion
broth or thioglycolate broth may be used.
4. Initial incubation at temperatures from
38 to 45 degrees C should be used.
5. Examine cultures for growth beginning at
48 hours and recheck daily for 2 weeks.

**Postprocedure Care**
1. Apply dry sterile dressing to site.

**Client and Family Teaching**
1. Avoid application of creams or lotions to
sample site and allow site to remain open
to air for healing.
2. At least 2-3 days are required for growth
and results.

**Factors That Affect Results**
1. *Nocardia* growth may be mistaken for
nontuberculous *Mycobacterium* when a
*Mycobacterium* culture medium is used.

**Other Data**
1. Common specimens include pus, tissue,
body fluid, and sputum.
2. Final reports may take 10 days.

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**Acid Hemolysin Test—Blood**
See Ham’s Test—Blood.

**Acidified Serum Test—Blood**
See Ham’s Test—Blood.

**Acid Perfusion (Bernstein) Test—Diagnostic**

**Norm.** No burning or pain after saline or
acidic infusions.

**Usage.** Differentiation between chest pain
cauised by a cardiac disorder and chest
pain caused by esophagitis. Not commonly
used by cardiologists; more often used
by gastroenterologists. Aids diagnosis of
gastroesophageal reflux as a cause of noctur-
nal asthma or hiatal hernia and in Barrett’s
esophagus. This test is obsolete if 24-hour
esophageal pH monitoring is available.

**Description.** Saline and then acidic solu-
tions are slowly perfused through a nasogas-
tric tube into the stomach. Clients with
esophagitis caused by relaxation of the lower
esophageal sphincter usually experience
burning or pain after the perfusion of acidic
solution but not after the saline solution.
Gastroesophageal reflux has been found to
occur in some clients with nocturnal asthma.
Such clients show an exacerbation of asthmatic
symptoms when this test is performed.

**Professional Considerations**
Consent form NOT required.

**Risks**
Exacerbation of asthma in asthmatics.
Complications of nasogastric tube inser-
tion include bleeding, dysrhythmias,
esophageal perforation, laryngospasm, and
decreased mean *pO*₂.

**Contraindications**
Cardiac disorders; esophageal varices.
Acid Phosphatase—Serum

**Norm.**

<table>
<thead>
<tr>
<th>Method</th>
<th>SI Units</th>
<th>SI Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodansky</td>
<td>0.5-2 U/L</td>
<td>2.7-10.7 IU/L</td>
</tr>
<tr>
<td>King-Armstrong</td>
<td>0.1-5 U/L</td>
<td>0.2-8.8 IU/L</td>
</tr>
<tr>
<td>Bessey-Lowery-Brock</td>
<td>0.1-0.8 U/L</td>
<td>1.7-13.4 IU/L</td>
</tr>
<tr>
<td>Gutman</td>
<td>0.1-2 U/L</td>
<td></td>
</tr>
</tbody>
</table>

**Increased.** Bone fracture, cancer with bone metastasis, Gaucher’s disease, hairy cell leukemia (leukemic reticuloendotheliosis), hepatitis (viral), hyperparathyroidism, hypophosphatemia, idiopathic thrombocytopenic purpura (with bone marrow megakaryocytes), jaundice (obstructive), Laënnec’s cirrhosis, leukemia (myelogenous), multiple myeloma, osteogenesis imperfecta, Paget’s disease (advanced), partial translocation trisomy 21, prostate cancer, prostatic infarction, prostatic surgery or trauma, renal impairment (acute), sickle cell crisis, thrombocythemia, thrombocytoysis, thromboembolism, and thrombophlebitis. Drugs include anabolic steroids.

**Decreased.** No clinical significance. Drugs include fluorides.

**Description.** Acid phosphatase is one of a group of enzymes located primarily in the prostate gland and prostatic secretions.
Smaller amounts are found in the bone marrow, spleen, liver, kidneys, and blood components such as erythrocytes and platelets. Isoenzymes of acid phosphatase include prostatic isoenzyme and erythrocytic isoenzyme. Used in diagnosis of and monitoring for treatment response of prostate cancer.

**Professional Considerations**

**Consent form NOT required.**

**Preparation**

1. Tube: Red topped, red/gray topped, or gold topped.

**Procedure**

1. Collect a 4-mL blood sample.

**Postprocedure Care**

1. Send the specimen to the laboratory immediately.
2. Separate the serum, add 0.01 mL of 20% acetic acid per milliliter of serum, and refrigerate if the test is not performed immediately.

**Client and Family Teaching**

1. Results may not be available for several days.

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**Factors That Affect Results**

1. Hemolysis or specimens received more than 15 minutes after collection invalidate results.
2. False-negative results may be attributable to use of a collecting tube containing fluorides, oxalates, or phosphates.
3. Drugs that cause false-positive results include clofibrate.
4. Elevated levels may be caused by rectal examination, prostatic massage, or urinary catheterization within 2 days before the test.

**Other Data**

1. This test is more helpful for diagnosis in advanced prostate cancer than in early prostate cancer.
2. Use of prostate-specific acid phosphatase as a tumor marker for prostate cancer is being replaced by Prostate-specific antigen—Serum.
3. See also Prostatic acid phosphatase—Blood.

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**Acid Phosphatase, Tartrate-Resistant—Blood**

See Tartrate-Resistant Acid Phosphatase—Blood.

**Acid Phosphatase—Vaginal Swab**

**Norm.** Method: Dilution with a substrate of thymolphthalein monophosphate.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>Normal vaginal secretions</td>
</tr>
<tr>
<td>&lt;7</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>7-50</td>
<td>Highly suggestive of coitus within past 36 hours</td>
</tr>
<tr>
<td>≥50</td>
<td>Confirmation of recent coitus</td>
</tr>
</tbody>
</table>

**Usage.** Rape trauma workup.

**Description.** Acid phosphatase is one of a group of enzymes located primarily in the prostate gland and prostatic secretions, with smaller amounts found elsewhere in the body. Normal vaginal secretions contain only low levels of acid phosphatase. Because acid phosphatase is found in such high concentrations in semen, its isolation in high levels from vaginal fluid in cases of suspected rape is strong evidence that coitus occurred recently.

**Professional Considerations**

Consent form NOT required unless specimen may be used as legal evidence.

**Preparation**

1. Obtain speculum, cotton wool swab supplied in a sexual offense kit, and sterile container.

**Procedure**

1. If the specimen may be used as legal evidence, have the specimen collection witnessed.
2. Position the client in the dorsal lithotomy position and drape for privacy and comfort.
3. Gently scrape the walls of the vagina with a plain cotton wool swab until it is saturated.
4. Place the swab in a sterile container.