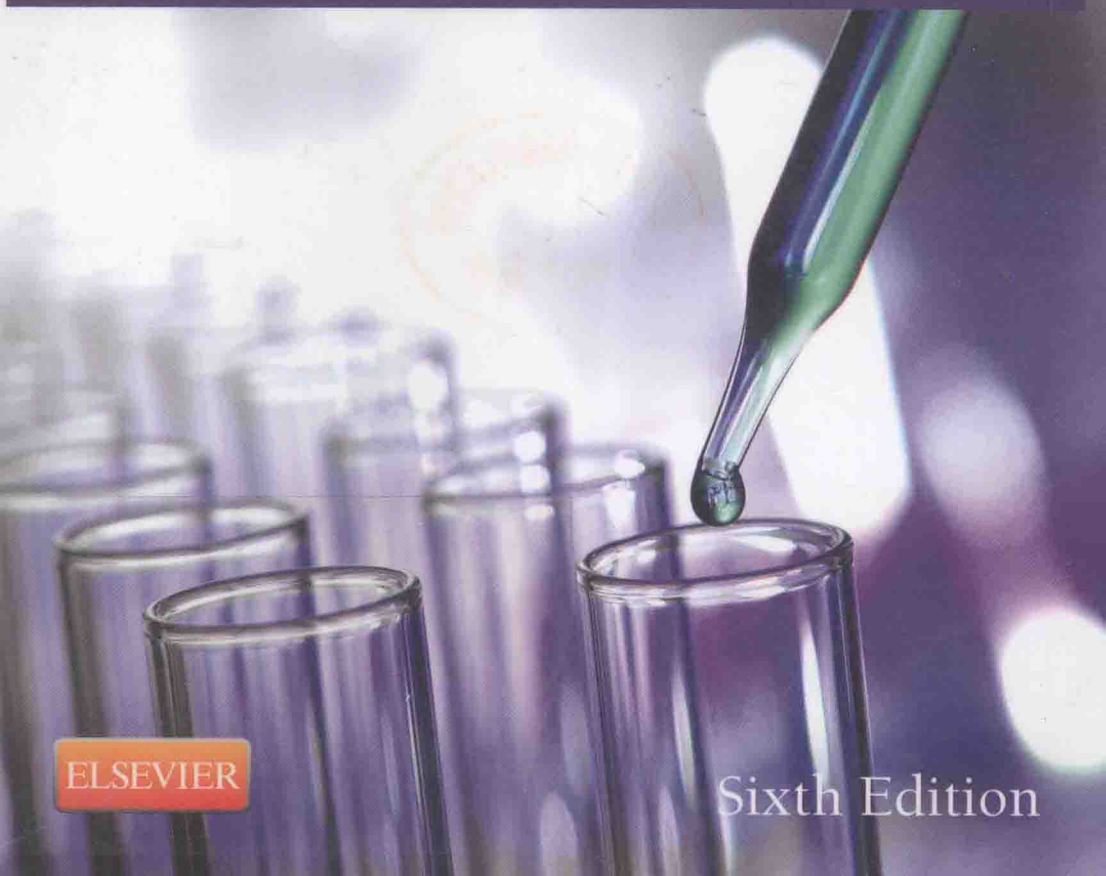
Cynthia C. Chernecky ■ Barbara J. Berger

Laboratory Tests and Diagnostic Procedures



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Sixth Edition

Laboratory Tests and Diagnostic Procedures

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LABORATORY TESTS AND DIAGNOSTIC PROCEDURES ISBN: 978-1-4557-0694-5

Library of Congress Cataloging-in-Publication Data

Laboratory tests and diagnostic procedures / edited by Cynthia C. Chernecky, Barbara J. Berger. – 6th ed.
p. ; cm.
Includes bibliographical references and index.
ISBN 978-1-4557-0694-5 (pbk. : alk. paper)
I. Chernecky, Cynthia C. II. Berger, Barbara J.
[DNLM: 1. Clinical Laboratory Techniques–Handbooks. QY 39]
616.07'5–dc23

2012041501

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Publishing Services Manager: Deborah Vogel
Project Manager: Bridget Healy
Design Direction: Maggie Reid

Printed in the United States of America

Last digit is the print number: 9 8 7 6 5 4 3 2 1

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PREFACE

We are pleased to announce the arrival of the sixth 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 required or recommended. The content is concise enough for novices and complete enough for seasoned practitioners. It has significant value for both students and practitioners of allied health, 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 genetic tests, 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 test or procedure. 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. In addition the CDC in 2007 developed the "2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings" and in 2011 developed a "Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care" that speaks to hand hygiene, personal protective equipment, injection safety, environmental cleaning, medical equipment and respiratory hygiene/cough etiquette.

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 Tamara Myers, 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

ACKNOWLEDGMENTS

It is with humble thanks that I dedicate this book to all those who have helped in its creation, support, and update and in particular to those who use it in their practice and education. Particular thanks to Jennifer Sweat, BSN student at GHSU, who helped with research and editing. This book has been a labor of love and continues to be used on both the national and international levels. I fully believe that an excellent clinical book on labs and diagnostics is what the clinical caregiver needs to give excellent care to persons who are ill and to all persons who have a right to disease prevention. There are others who, though they did not write, were supportive in ways that we can all understand—these are people who have integrity, caring souls, faith, and a sense of humor: my mother Olga, late father Edward Chernecky, godmother Helen Prohorik, godsons Jonathon Tarutis and Vincent Hunter, goddaughters Ekaterina McNeill and Dawn Priscilla Payne, brother Dr. Richard Chernecky, nieces Ellie Burton and Annie Chernecky, nephew Michael Chernecky, great nephew William "Liam" Burton, Cliff Burton, Budnik family; cousins Paula Smart, Karyn Tarutis, Philip Prohorik, Ed Sztuka, Eileen Sztuka, Tyler Sztuka, and Benjamin Sztuka; friends Olga, Don and Peter McNeill, Yelena and Igor Senko, Elaine Calugar, Phyllis Skiba, David and Janice Douglass, Frankie Ekroyd, Andrea Burton, Molly Loney; colleagues Dr. Joyceen Boyle, Dr. Jean Brown, Dr. Linda Burnes-Bolton, Dr. Mary Cooley, Dr. Leda Danao, Kitty Garrett, Beverly George-Gay, Dr. Rich Haas, Becki Hodges, Dr. Ann Kolanowski, Dr. Elisabeth Monti-Siebert, Dr. Ruth McCorkle, Dr. Linda Sarna, Dr. Geri Padilla, Dr. Autumn Schumacher, Dr. Shirley Quarles, Denise Macklin, Dr. Marlene Rosenkoetter, Dr. Georgia Narsavage, Dr. Beverly Roberts, Dr. May Wykle, Rebecca Rule, Paula T. Rieger, Dr. Rob Lafferty; and those who keep me focused in life itself: Mother Thecla (Abbess), and Mother Helena and Mother Luybov of Saints Mary and Martha Orthodox Monastery in South Carolina, Priest Gregory and Presbytera Raisa Koo, Priest Antonio and Matushka Elizabeth Perdomo, and Heirmonk Fr. Cyprian DuRant. It never fails to surprise me when I meet an Orthodox member of His Holy, Catholic, and Apostolic Church who has found true joy in that he or she has found the truth in the faith that we trace back to the time of Christ himself. I know from my life that the truth is worth the search.

To the universities that have shared their knowledge with me, I thank the University of Connecticut, Yale University, University of Pittsburgh, Clemson University, Case Western Reserve University, University of Wisconsin Oshkosh, and the University of California at Los Angeles.

As we continue in further editions of this book, I do not know what else to say about my coeditor, coauthor, friend, and colleague Barb Berger. We work well together, know how to laugh, know how to work hard, and have a commitment to care with an eye for quality research to make each and every edition packed with quality information and timely updates. This book is a massive project, and I could not have accomplished it without trust, equality, respect, and admiration, which is what Barb and I have for one another and why we make such a great team. Barb, you are a distinguished professional and a great role model, which adds not just to this book but to the discipline and profession of nursing.

To all nurses, physicians, attorneys, and other health care professionals who give true meaning to this book by using it, we respect your comments and suggestions—after all we are all striving for the same goals in our respective services.

Cynthia (Cinda) Cecilia Chernecky

My thanks and gratitude for their meticulous attention to detail and sharing of their expertise go to current and past contributors and reviewers of this text. I am appreciative of our oh-so-meticulous experts at Elsevier, Tamara Myers and Bridget Healy, who made the process from manuscript-to-production go smoothly and stay on schedule. Thanks go to my husband,

Stephan Berger, who shares my pride in this work and does more than his fair share keeping the home front running so that I can spend time working on the manuscript. My mother, Alice Adams, once again supported and encouraged my work on this sixth edition. Finally, massive thanks to Cinda Chernecky, my **awesome** and excellent coeditor and friend, who never fails to amaze me with her depth and breadth of knowledge, pitch-in attitude and unending optimism!

Barbara J. Berger

HOW TO USE THIS BOOK

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 bullet.

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

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Complete blood count, Blood
Endometrium, Anaerobic, Culture
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(see Shock)

Anemias

(see Aplastic, Dyserythropoietic, Folic acid, G6PD deficiency, Galactokinase deficiency, Heinz body, Hemolytic, Iron [hypochromic] deficiency, Megaloblastic, Pernicious, or Sickle cell anemias)

Anesthesia

(see Surgery, Preoperative; Surgery, Postoperative)

Aneurysm

(see Aneurysm, Abdominal aortic; Aneurysm, Cerebral; Aneurysm, Thoracic aortic)

Aneurysm, Abdominal Aortic

• Abdominal aorta ultrasonography, Diagnostic
Cardiac catheterization, Diagnostic

Chest radiography, Diagnostic
• Computed tomography of the body (Abdomen), (Spiral), Diagnostic
• Flat-plate radiography of abdomen, Diagnostic
Fluorescent treponemal antibody–absorbed double-stain test, Serum
Lipid profile, Blood
• Magnetic resonance angiography, Diagnostic
• Magnetic resonance imaging, Diagnostic
Rapid plasma reagin test, Blood
Venereal Disease Research Laboratory test, Serum

Aneurysm, Cerebral

Activated partial thromboplastin time and partial thromboplastin time, Plasma
• Cerebral angiography, Diagnostic
• Cerebral computed tomography, Diagnostic
Cerebrospinal fluid, Protein, Specimen
Computed tomography of the body (HRCT), Diagnostic
Doppler ultrasonographic flow studies, Diagnostic (Transcranial)
Lumbar puncture, Diagnostic
• Magnetic resonance angiography, Diagnostic
• Magnetic resonance imaging (Brain), Diagnostic
Prothrombin time and international normalized ratio, Plasma

Aneurysm, Thoracic Aortic

• Chest radiography, Diagnostic
• Computed tomography of the body (Abdomen, chest), (Spiral), Diagnostic
Fluorescent treponemal antibody–absorbed double-stain test, Serum
Lipid profile, Blood
• Magnetic resonance angiography, Diagnostic
• Pulmonary angiography, Diagnostic
Rapid plasma reagin test, Blood
• Transesophageal ultrasonography, Diagnostic
Venereal Disease Research Laboratory test, Serum

Angina Pectoris

Anticardiolipin antibody, Serum
Antimyocardial antibody, Serum
Aspartate aminotransferase, Serum
Cardiac calcium scoring, Diagnostic
Cardiac catheterization, Diagnostic
Chest radiography, Diagnostic
Complete blood count, Blood (Hemoglobin)
Computed tomography of the body (EBCT), Diagnostic
• Coronary intravascular ultrasonography, Diagnostic
C-reactive protein (High sensitivity), Serum
Creatine kinase, Serum (Isoenzymes)
D-Dimer test, Blood
Echocardiography, Diagnostic
• Electrocardiography, Diagnostic
Ergonovine provocation test, Diagnostic
Glucose, Blood
Heart scan, Diagnostic
Holter monitor, Diagnostic
Homocysteine, Plasma or urine
Lactate dehydrogenase, Isoenzymes, Blood
• Lipid profile, Blood
Positive emission tomography, Diagnostic
• Stress exercise test, Diagnostic
• Stress test, Pharmacologic, Diagnostic
Troponin I, Plasma and troponin T, Serum

Ankylosing Spondylitis

Antinuclear antibody, Serum
Bone scan, Diagnostic
Computed tomography of the body, Diagnostic
• C-reactive protein, Plasma or serum
Human leukocyte antigen B27, Blood
• Immunoglobulin G, Serum
Immunoglobulin M, Serum (Rheumatoid factor)
Magnetic resonance imaging (Sacroiliac spine), Diagnostic
Protein electrophoresis, Serum
• Radiography (Bone), Diagnostic
Rheumatoid factor, Blood
• Sedimentation rate, Erythrocyte, Blood

Anorexia Nervosa

Bone densitometry, Diagnostic
Complete blood count, Blood
Comprehensive metabolic panel, Blood
Differential leukocyte count, Peripheral blood
Electrocardiography, Diagnostic
Electrolytes, Plasma or serum
• Estradiol, Serum
17-Hydroxycorticosteroids, 24-hour urine
Low-density lipoprotein cholesterol, Blood
• Luteinizing hormone, Blood
Phenolphthalein test, Diagnostic
Potassium, Plasma or serum