Preface

Welcome to the third edition of McGraw-Hill's *Palko's Medical Laboratory Procedures.* The origin of this text began at a time when the number of clinical laboratories in ambulatory care facilities was increasing and quality control was mandated by CLIA 1988 and laboratory safety by OSHA. Since then, challenges in the labs have been met with additional requirements and many advances have been made in testing. This text includes theory and principles of clinical laboratory science; laboratory testing procedures, manual and automated, that have been around for decades; as well as current automated and point-of-care laboratory procedures.

This edition is revised, rearranged, and updated in honor of the late Tom Palko and his widow, Hilda, who both worked for many years in the medical laboratory field; Tom then spent over 25 years teaching in the allied health sciences, including medical technology and medical assisting.

This text can serve in the following ways:

- as a textbook for an orientation course in laboratory medicine for students beginning the study in medical technology or clinical laboratory science.
- as a textbook in the clinical laboratory portion of the curriculum for students of allied health sciences, especially medical assisting programs and medical technician programs.
- as a source of reference for personnel working in a clinical laboratory, particularly an ambulatory care facility.

Because this text can be utilized by so many different health professionals, for the purpose of this book, anyone performing laboratory tests will be referred to as lab personnel.

Effective clinical laboratory personnel must understand the theory, principle, and pathology behind the testing procedures. Knowing about the conditions and diseases that alter the lab test results, medical personnel will contribute even more to the care of the patient and thus make the job more meaningful and enjoyable. Due to advances in laboratory instrumentation, microtesting, and simplified testing procedures, today many laboratory tests are run in the physician's office laboratory. Quality assurance programs are so explicit that the physicians can rely on the accuracy of test results for both diagnosis and treatment of the patient. The more knowledge and practice the lab personnel has about all areas of the clinical laboratory, the more enhanced the contribution is to total patient care.

Instructors will find great improvements and new features in this third edition. Obviously, the first noticeable feature will be addition of color, making, for example, cellular differentiation, testing procedures, and general visuals much easier to learn, teach, and read. Safety regulations from OSHA and total quality assurance have been updated and used throughout the text. Current HIPAA regulations appropriate to the laboratory, along with proper record keeping, have been updated and expanded. Review of math and statistical calculations is again included but with additional problems for those students who need more practice. The section on blood collection has been extended and examples of current testing procedures in hematology, urinalysis, chemistry, immunology, and microbiology are included. Laboratory procedures have been modified to include performance standards and evaluation scores. Common laboratory equipment can now be found in the appendix along with laboratory vocabulary, reference values for common laboratory tests, and CLIA levels of certification.

ORGANIZATION

This is a competency-based textbook and reference that functions also as a workbook and laboratory manual. The book is organized into six units.

Unit I, Introduction to the Physician's Office Laboratory, is the introduction to the laboratory and includes safety, math, statistics, quality control, and record keeping.

Unit II, Urinalysis, includes the urinary system and collection and analysis of urine specimens.

Unit III, Blood Collection, is new and covers blood collection including capillary, venipuncture, and advanced venipuncture procedures.

Unit IV, Hematology, is on hematology and hematology testing of whole blood components

and also includes coagulation principles and testing.

Unit V, Blood Chemistry, is the section on complications of diabetes and glucose testing, along with other chemistry analytes.

Unit VI, Immunology and Microbiology, includes the immunology and microbiology chapters.

WHAT'S NEW

Chapter-specific changes are

- **Laboratory Safety**—Updates and requirements from CDC and OSHA can be found in Chapter 1, along with the addition of information on new safety devices, standard precautions, hepatitis C, and how to locate current information on issues that lab personnel may encounter. OSHA Bloodborne Pathogen Standards have been added to the appendix, as well as an example of an exposure report form.
- **Microscopy**—Details of the compound microscope are again included in Chapter 2 with color photos of microscope parts and the proper use.
- **Math Review**—The addition of a section in Chapter 3 teaching the dimensional analysis process of converting from one unit to another will be helpful for English to metric or metric to metric conversions. Also, adding 60 extra problems with fractions, equations, percents, and making solutions will help those students needing further practice.
- **Statistics**—Chapter 4 remains important in the course because of quality control calculations. It simplifies statistical calculations that are used each day by lab techs. In accredited med tech programs, students are required to take a separate course in statistics.
- **Quality Assurance and Quality Control**—Chapter 5 has been revised to include current terminology that is being utilized today.
- **Record Keeping in the POL**—Chapter 6 has included information on HIPAA as it relates to the laboratory. In addition, it includes information about oral communication in the laboratory.
- **Urinary System—Anatomy and Physiology**—Chapter 7 has been reorganized to focus on the anatomy and physiology most critical to understand urinalysis testing and patient test results.
- **Urine Collection and Preservation and Physical, Chemical, and Microscopic Analysis of Urine Specimens**—The entire Urinalysis unit (Chapters 8–10) has been reorganized for better correlation and understanding.
- **Blood Collection: Routine Venipuncture and Advanced Venipuncture Techniques**—This new unit (Chapters 11 and 12) provides detailed instruction on how to perform routine venipuncture, venipuncture utilizing a syringe, venipuncture utilizing a butterfly needle, as well as capillary specimen collection. The chapters include updated safety procedures.
- **Hematology**—Chapters 13–17 include manual and updated automated methods of counting, measuring, and analyzing whole blood, either capillary or venous blood, for all components of CBCs, platelet counts, sedimentation rates, reticulocyte counts, and other hematology techniques. Principles of blood formation, the body's responses to disease processes, and comparing test results have been enhanced and expanded.
- **Coagulation**—Current information about coagulation studies and disorders has been included in Chapter 18. Also, point-of-care (POC) instruments using capillary blood to test prothrombin times to monitor patients on coumadin therapy have been included and the use of INR results has been added.
- **Blood Glucose and Other Chemistry Tests**—These chapters (Chapters 19 and 20) remain essential to the student as a core of laboratory testing and include updated diabetes terminology and guidelines and information about POC testing.
- **Immunology Tests**—This is an area of the laboratory where advances in sensitivity and specificity have made available on-the-spot testing for a variety of disorders or conditions from HCG to HIV. Many CLIA-waived kits are now available and allow the physician to evaluate and treat patients earlier. Numerous examples are given in Chapter 21 along with sample procedures.
- **Microbiology**—Chapter 22 has been expanded to include examples of automated bacterial identification systems used in larger clinic laboratories. More photos and diagrams of microbes, both normal and pathogenic, have been added, along with diagrams to show collection of specimens for culturing.

WHAT EVERY STUDENT NEEDS TO KNOW

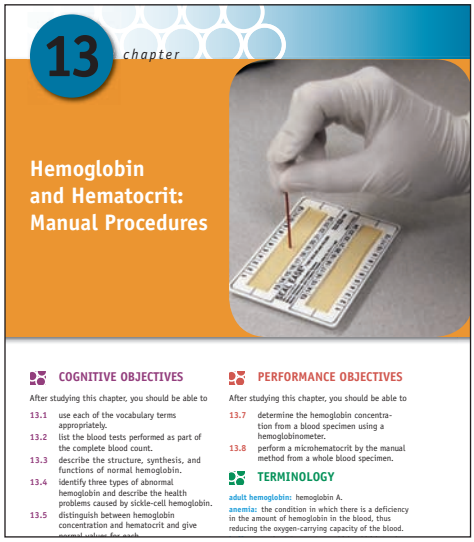
Many tools to help you learn have been integrated into your text.

CHAPTER FEATURES

Cognitive Objectives
present a list of the key points you should focus on in the chapter.

Performance Objectives
outline the tasks that you should be able to complete after studying the chapter.

Terminology
highlights important chapter terms and definitions that will assist you in understanding the content.


13 chapter

Hemoglobin and Hematocrit: Manual Procedures

COGNITIVE OBJECTIVES

After studying this chapter, you should be able to

13.1 use each of the vocabulary terms appropriately.
13.2 list the blood tests performed as part of the complete blood count.
13.3 describe the structure, synthesis, and functions of normal hemoglobin.
13.4 identify three types of abnormal hemoglobin and describe the health problems caused by sickle-cell hemoglobin.
13.5 distinguish between hemoglobin concentration and hematocrit and give

PERFORMANCE OBJECTIVES

After studying this chapter, you should be able to

13.7 determine the hemoglobin concentration from a blood specimen using a hemoglobinometer.
13.8 perform a microhematocrit by the manual method from a whole blood specimen.

TERMINOLOGY

adult hemoglobin: hemoglobin A.
anemia: the condition in which there is a deficiency in the amount of hemoglobin in the blood, thus reducing the oxygen-carrying capacity of the blood.

Reminder Boxes, Information Boxes, Note Boxes
provide focus and helpful hints on key chapter information.

Phlebotomy Supply Checklist

It is important that you remember to check the supplies in your phlebotomy tray every day to ensure that you have the items you need for each procedure. The following checklist should be used as a template. Modify as needed to meet the needs of your own POL, including maintaining minimums.

Tables
summarize data and help organize concepts.

Performance Standards	Points Awarded	Maximum Points
1. Wash your hands with disinfectant, dry them, and put on gloves, face shield, and apron or lab coat.		5
2. Follow standard precautions.		5
3. Assemble and prepare the appropriate equipment and supplies.		5
4. *Prepare the hemoglobinometer according to the manual supplied, checking calibration and/or optical self-test and hemoglobin controls.		15
5. *Inspect the EDTA-anticoagulated blood for proper labeling.		15
6. Mix the tube of EDTA-anticoagulated blood thoroughly.		5
7. Remove the cap from the tube of blood, using a tissue or cap remover; take care to avoid splattering blood.		5
8. *Load the microcuvettes, or other measuring device supplied or recommended by the manufacturer of the hemoglobinometer, with blood and wipe off any excess blood from the outside of the cuvette.		10
9. Load the cuvette into the holder of the photometric reader and push the measuring position.		5
10. Read the hemoglobin value from the display and record.		10

Figures
Colorful illustrations and photos add to the understanding of topics.


(a) (b) (c)

Figure 11-4 Various needles with safety mechanisms: (a) hinged cap; (b) protective shield; (c) retractable needle.

hurt more but are less likely to cause a hemolyzed specimen, thus requiring the specimen to be recollected; (2) smaller needles are less painful but tend to take longer to collect a specimen and are more likely to cause hemolysis in the specimen. Needles should be sterile—never use a needle in which someone other than you has broken the seal at the time of collection. Needles can only be used once and must be discarded in a biohazardous sharps container after they have been used. Never bend, break, or recap needles. In addition, the Needlestick Safety and Prevention Act signed by former President Clinton in 2000 requires that all needles have a safety mechanism to help avoid accidental **needlesticks.** Each manufacturer uses its own safety mechanism, so be sure to familiarize yourself with the mechanism PRIOR to the use of the needle.


Figure 11-5 Examples of needle holders.

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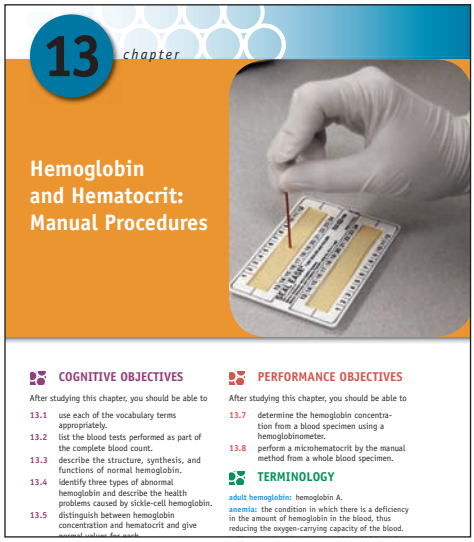
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7. Remove the cap from the tube of blood, using a tissue or cap remover; take care to avoid splattering blood.		5
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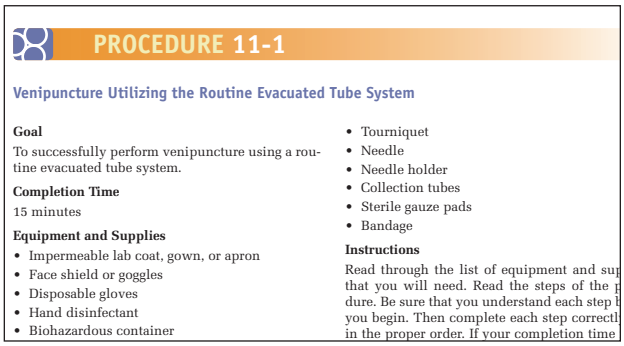
Procedure Competency Checklists

provide detailed lists and expectations for competency performance.



PROCEDURE 11-1

Venipuncture Utilizing the Routine Evacuated Tube System

Goal

To successfully perform venipuncture using a routine evacuated tube system.

Completion Time

15 minutes

Equipment and Supplies

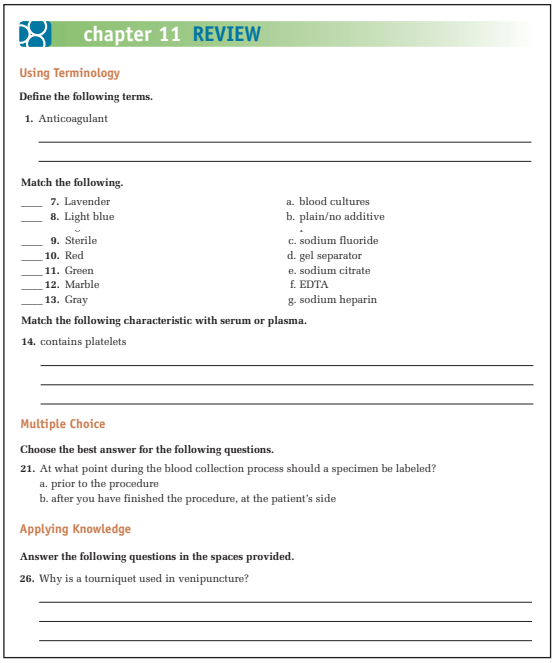
- Impermeable lab coat, gown, or apron
- Face shield or goggles
- Disposable gloves
- Hand disinfectant
- Biohazardous container
- Tourniquet
- Needle
- Needle holder
- Collection tubes
- Sterile gauze pads
- Bandage

Instructions

Read through the list of equipment and su
that you will need. Read the steps of the p
dure. Be sure that you understand each step b
you begin. Then complete each step correctl
in the proper order. If your completion time

End-of-Chapter Review (Matching, Multiple Choice, Applying Knowledge)

checks your understanding and mastery of chapter content.



chapter 11 REVIEW

Using Terminology

Define the following terms.

1. Anticoagulant

Match the following.

7. Lavender
8. Light blue
9. Sterile
10. Red
11. Green
12. Marble
13. Gray

a. blood cultures
b. plain/no additive
c. sodium fluoride
d. gel separator
e. sodium citrate
f. EDTA
g. sodium heparin

Match the following characteristic with serum or plasma.

14. contains platelets

Multiple Choice

Choose the best answer for the following questions.

21. At what point during the blood collection process should a specimen be labeled?
    a. prior to the procedure
    b. after you have finished the procedure, at the patient's side

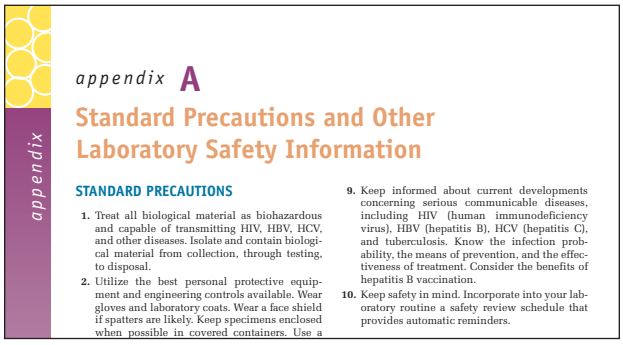
Applying Knowledge

Answer the following questions in the spaces provided.

26. Why is a tourniquet used in venipuncture?

Appendices

offer additional information that is pertinent to the medical laboratory.



appendix A

Standard Precautions and Other Laboratory Safety Information

STANDARD PRECAUTIONS

1. Treat all biological material as biohazardous and capable of transmitting HIV, HBV, HCV, and other diseases. Isolate and contain biological material from collection, through testing, to disposal.
2. Utilize the best personal protective equipment and engineering controls available. Wear gloves and laboratory coats. Wear a face shield if spatters are likely. Keep specimens enclosed when possible in covered containers. Use a
9. Keep informed about current developments concerning serious communicable diseases, including HIV (human immunodeficiency virus), HBV (hepatitis B), HCV (hepatitis C), and tuberculosis. Know the infection probability, the means of prevention, and the effectiveness of treatment. Consider the benefits of hepatitis B vaccination.
10. Keep safety in mind. Incorporate into your laboratory routine a safety review schedule that provides automatic reminders.

Online Learning Center

www.mhhe.com/CoxPalkoMedLab3e
offers additional learning and teaching tools.