

Virginia Western Community College

MDL 140 Clinical Urinalysis

Prerequisites

Successful completion of BIO 101 or equivalent.

Course Description

Focuses on urinalysis studies including physical and chemical properties, microscopic techniques. Emphasizes the significance of abnormal results. Lecture 1 hour. Laboratory 3 hours. Total 4 hours per week.

Semester Credits: 2

Lecture Hours: 1

Lab Hours: 3

Total: 4 hours per week

Required Materials

Textbook:

Graff's Textbook of Urinalysis and Body Fluids, Third Edition, Lillian A. Mundt, Kristy Shanahan Wolters
Kluwer, 2016. ISBN 978-1-4963-2106-2

Course Outcomes

At the completion of this course, the student should be able to:

- Understand the physiology and pathophysiology of the human renal and urinary systems
- Identify proper collection and storage of urine samples
- Explain how to instruct a patient on collection and storage of specimens
- Manually perform a complete urinalysis including macroscopic and microscopic examinations
- Correlate chemical reactions in urine tests to urine dipstick methodology
- Interpret the results of a urine dipstick test, realizing that there are several different brands and types of dipsticks available
- Correlate an abnormal dipstick result to a possible clinical condition, such as the presence of blood cells or hemoglobin in the urine or the presence of proteins in the urine
- Accurately identify types of cells that can appear in urine, including red and white blood cells and epithelial cells
- Accurately identify types of renal casts that can appear in urine, and be able to correlate the appearance of casts to various disease states
- Identify the presence of bacteria and parasites in the urine and be able to correctly identify the types of parasites
- Differentiate normal urine artifacts and contaminants such as fibers from abnormal cells, casts and parasites
- Identify and differentiate acidic and basic urine crystals and amorphous solids
- Explain types of automation used to perform urinalysis and understand the protocols for proper instrument quality control
- Perform and calculate results of manual cell counts for body fluids
- Use knowledge base to evaluate cerebrospinal, synovial, and amniotic fluids test results

Topical Description**Course Outline**

Lecture Topic / Objectives

Lab / Objectives

PART 1. Background

Week 1 Urinalysis Clinical Laboratory Operations - Chapter 4

1. Define compliance and discuss how it relates to urinalysis and body fluid analysis.
2. List four categories of clinical laboratory testing under CLIA '88 and which personnel may perform laboratory tests in these categories.
3. Discuss external accreditations and CLSI standards and their importance in laboratory management and compliance.
4. Describe legal and ethical concerns related to the clinical laboratory.
5. Summarize the scope of and importance of quality assessment.
6. Explain how the components of quality assessment are implemented in the clinical laboratory.

Collection and Preservation of Urine -Chapter 6

1. Compare the methods of urine collection.
2. Suggest appropriate urine collection method depending on testing ordered.
3. Compare urine preservation methods.
4. Select appropriate urine collection method depending on testing ordered.
5. Explain what changes occur in unpreserved urine over time.

Week 2 Urinary System Anatomy and Physiology and Urine Formation - Chapter 1

1. List the six major functions of the kidney and urinary system.
2. Sketch the urinary tract, labeling each of the four basic anatomical components.
3. Diagram the kidney and the structures it contains.

Introduction

Laboratory Safety & Specimen Collection, Handling, Labeling and Storage - Chapters 4 and 6

Safety in the clinical laboratory:

1. Explain the responsibility of laboratories to develop and publicize safety policies and procedures.
2. Identify and describe six types of safety risks that exist in the clinical laboratory.
3. Identify the components of the chain of infection and give examples of each, describe infection-control procedures used to break the chain, and identify four functions of infection-control programs.
4. Describe proper procedures for hand hygiene, and putting on and removing protective clothing.
5. Describe standard and transmission-based precautions and identify the organizations that developed them.
6. State safety rules to follow when working in the laboratory.
7. List examples of blood-borne pathogens and describe their means of transmission in a healthcare setting.
8. Discuss the major points of the blood-borne pathogens (BBP) standard, and identify key elements of a BBP exposure control plan.
9. Describe hazards, identify warning symbols, list actions to take if incidents occur, and specify rules to follow for proper biological, electrical, fire, radiation, and chemical safety.
10. Comply with standard precautions, proper use of PPE, handling of hazardous materials, and disposal of sharps in the laboratory.
11. Compare chemical labeling symbols.
12. Interpret the meaning of various safety symbols and pictograms.

Laboratory Equipment used for UA

1. Discuss equipment utilized in urinalysis to include preventative maintenance, quality control/ calibration/ standardization: timers, pipettes, centrifuge, analyzers,

4. Identify the main functional unit of the kidney.
5. Identify the structures and components of the nephron.
6. Describe the functions of the glomerulus, the tubule, and the loop of Henle.
7. Describe the process of glomerular filtration and list what is filtered and what is not filtered from blood.
8. Describe what happens to the glomerular ultrafiltrate as it becomes the urine that is excreted.
9. Define renal threshold and countercurrent mechanisms. State the renal threshold range for glucose.
10. Discuss the reabsorption process and what is reabsorbed.
11. Explain the role of the kidney in ion secretion and acid-base balance and identify the roles of hydrogen ions, bicarbonate ions, and ammonium ions in accomplishing this balance.
12. Describe the effect of each of the following and their effect on urine production: a) aldosterone, b) renin, and c) vasopressin.
13. List the major organic and inorganic constituents of urine.
14. List three areas of patient's renal function assessment.
15. Suggest appropriate urine collection method depending on testing ordered.
16. Compare urine preservation methods.
17. Discuss the formula for the classic creatinine clearance and discuss its value.
18. List three factors that can affect classical creatinine clearance testing.
19. Name three method for calculating an estimated glomerular filtration rate (eGFR)
20. List and discuss additional tests to assess kidney function (cystatin C, microalbumin, and β 2-micralbumin)
21. Name tests for assessing tubular secretion functions and renal secretory function.

microscope, hydrometer, refractometer, osometer, etc.

Automation – Chapter 20

1. Discuss rationales for using automated systems for urinalysis and body fluids examination.
2. List some available automated systems.

Physical Examination of Urine – Chapter 7:

1. Explain what is included in physical examination of urine.
2. Identify normal and abnormal urine color and clarity.
3. Suggest causes for urine odor, color, and clarity.
4. Describe the methods for measuring urine concentration.
5. State normal values for urine concentration.
6. Suggest causes for abnormal urine concentration.

Urinalysis - Physical Examination

1. Perform urine physical examination accurately, to include color, clarity, concentration (specific gravity and refractive index using the Refractometer and Urinometer) and miscellaneous (i.e. odor, foam)
2. Correlate physical examination results with pathologic and non-pathologic conditions.

Week 3 Test

PART 2. Urinalysis

Week 4 Physical Examination of Urine – Chapter 7

1. Explain what is included in physical examination of urine.
2. Identify normal and abnormal urine color and clarity.
3. Suggest causes for urine odor, color, and clarity.
4. Describe the methods for measuring urine concentration.
5. State normal values for urine concentration.
6. Suggest causes for abnormal urine concentration.

Lab Quiz/ Practical

Urinalysis

Physical Examination

Chemical Examination

1. Accurately Perform
 - urine pH using pH paper and dipstick
 - urine specific gravity using hydrometer and refractometer
 - urine chemical tests accurately utilizing the dipstick methodology from multiple manufacturers'
 - confirmatory urine chemical tests (tablet) accurately
2. Practice
 - documenting reagent QC (lot, expiration, results)
 - refractometer QC using DI water and other controls or standards

- correlate which confirmatory tests relate to tests impregnated on commonly used chemical strips.

Week 5 Chemical Examination of Urine – Chapter 8

For Each Chemical Test Performed by Dipstick Methodology

1. Describe the principle and procedure, for each chemical test
2. Compare and contrast the reagent strip characteristics among manufacturers
3. Interpret the results of urine chemistry tests
4. Define normal expected values
5. Suggest the causes for abnormal findings
6. Identify the sources of error
7. Suggest appropriate confirmatory tests
8. Correlate results of chemical tests with those of physical examination
9. Predict findings of microscopic examination

For the Confirmatory Urine Tests (Tablet Tests)

10. Describe the principle and procedure
11. Interpret the results
12. Recognize the sources of error
13. Suggest appropriate clinical applications

Week 6 Microscopic Examination of Urinary Sediment – Chapter 9

1. Compare methods of specimen preparation.
2. Describe the procedure for proper microscopic examination and enumeration of urinary sediment.
3. Identify causes for altered appearance and distribution of urinary sediment on the slide.
4. Describe characteristics of urine sediment.
5. Recognize sources of error in identification of urine sediment.
6. Suggest methods to confirm the identification of urine sediment (staining, alternate microscopy, solubility tests).
7. Compare methods of specimen preparation.
8. Describe the procedure for proper microscopic examination and enumeration of urinary sediment.
9. Identify causes for altered appearance and distribution of urinary sediment on the slide.
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11. Recognize sources of error in identification of urine sediment.
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Atlas of Urinary Sediment – Chapter 10

1. Identify cells which may be found in urinary sediment.
2. Identify crystals that may be found in acidic urine.
3. Identify crystals that may be found in alkaline urine.
4. Identify casts that may be found in urinary sediment.
5. Identify microorganisms that may be found in urinary sediment.
6. Identify artifacts that may complicate the identification of urinary sediment.

Urinalysis

Physical Examination

Chemical Examination

- Chemistry Supplemental Testing
1. Compare and contrast differences between manufacturers' chemical test strips.
 2. Study procedures for common urine confirmatory tests.
 3. Interpret results of common urine confirmatory tests.
 4. List possible causes of false test results for chemical dipstick methodology.

Microscopic Examination of Urine Microscopy - Chapter 5

1. Identify the parts of a compound microscope
2. Explain the function of each microscope component
3. Differentiate among the basic principles of microscopy techniques presented in this chapter
4. Suggest appropriate use of microscopy techniques
5. Explain methods used to adjust illumination
6. Explain methods used to improve image contrast
7. Outline proper handling and care of a microscope

Urinalysis –

- Physical Examination
 - Chemical Examination
 - Microscopic Examination- Sample Prep
1. Practice
 - Accurately aliquoting and labeling urine samples for microscopic examination
 - Preparation of urine samples for microscopic examination: centrifugation and re-suspension
 2. Perform (using unstained and stained sediment and photographs from slide presentations)
 - Identify cells that may be found in urine sediment.
 - Identify crystals that may be found in acidic urine.

7. Recognize when bright field, phase contrast, polarized light, and interference contrast microscopy have been used.
8. Recognize when Sternheimer- Malbin staining and other staining have been used.
9. Compare and contrast urinary sediment viewed using bright field, phase contrast, polarized light, and interference contrast microscopy.
10. Compare and contrast urinary sediment viewed using bright field, Sternheimer- Malbin staining, and Sudan II staining.
11. Recognize when sediment has been stained by bilirubin.
12. Differentiate between true urinary sediment and artifacts.

- Identify crystals that may be found in alkaline urine.
 - Identify casts that may be found in urine sediment.
 - Identify microorganisms that may be found in urine sediment
 - Identify artifacts that may complicate the identification of urinary sediment.
 - Identify and name the different types of casts that can be formed.
3. Explain clinical significance of cast formation.
 4. Correlate cast formation with clinical conditions.
 5. Explain crystal formation.
 6. Explain clinical significance of crystal formation.
 7. Correlate crystal formation with clinical conditions.
 8. Differentiate biological urine sediment components.
 9. Discuss common urine artifact.
 10. Differentiate common urine artifact.

Week 7 Test

Week 8 Renal Disease - Chapter 2

1. Define the following: Glomerulonephritis, nephrosis, glomerulosclerosis, cystitis, and pyelonephritis
2. Describe and discuss the typical signs and symptoms of kidney stones, the types of stones, and laboratory tests that may be ordered for patients with stones.
3. Categorize the various renal diseases in this chapter as to whether they are glomerular, tubular, interstitial, or vascular in origin.
4. Describe how immunologic processes damage the kidneys.
5. Match urinalysis findings with urinary tract and kidney diseases.
6. Differentiate between findings in cystitis and kidney diseases.
7. Differentiate between membranous and membranoproliferative glomerulonephritis.
8. Discuss the course of disease for IgA nephropathy and the associated laboratory findings.
9. Name a urinary finding that is diagnostic of renal tubular damage.
10. Discuss diabetic nephropathy and the development of end-stage renal disease in diabetic patients.
11. Differentiate between diabetic nephropathy, diabetes insipidus, and syndrome of inappropriate antidiuretic hormone.

Week 9 Urine Screening for Metabolic Disorders – Chapter 3

1. Differentiate between findings in cystitis and kidney diseases.

Practical UA

Physical and Chemical Examination

Urinalysis

Physical Examination

Chemical Examination

Microscopic Examination – stain (see week 6 objectives)

Urinalysis

Microscopic Examination –

- Artifacts, Inclusions

2. Differentiate between membranous and membranoproliferative glomerulonephritis.
3. Discuss the course of disease for IgA nephropathy and the associated laboratory findings.
4. Name a urinary finding that is diagnostic of renal tubular damage.
5. Discuss diabetic nephropathy and the development of end-stage renal disease in diabetic patients.
6. Differentiate between diabetic nephropathy, diabetes insipidus, and syndrome of inappropriate

(see week 6 objectives)

Week 10 Test

Practical UA- Microscopic Examination

PART 3. Other Body Fluids

Week 11

Introduction to Body Fluids -Chapter 11

1. Describe the composition of body fluids
2. Describe the main function of body fluids.
3. Explain the process of fluid accumulation in body cavities.
4. Name the procedure used to collect fluid from each body cavity.
5. List the tests that are normally performed on body fluids.
6. List the causes for abnormal appearance of body fluids.
7. Explain the use of a hemocytometer in performing body fluid cell counts.
8. Correlate diluents that may be used during hemocytometer counts with the fluid for which they most likely would be used.
9. Explain the use of a centrifuge in preparing smears.
10. Suggest techniques to minimize cell destruction during smear preparation

Cerebrospinal Fluid- Chapter 12

1. Explain the utility of cerebrospinal fluid analysis in evaluating the central nervous system.
2. Explain the function of cerebrospinal fluid (CSF).
3. Explain the function of the blood-brain barrier.
4. List the indications and contraindications for performing a CSF analysis.
5. Describe the anatomy of the central nervous system.
6. Explain the formation, circulation and reabsorption of CSF.
7. Name and describe the procedure for collection of CSF.
8. Compare and contrast CSF chemistry results in health and disease.
9. List the normal constituents of CSF and their normal levels.
10. Discuss the mechanism for maintenance of normal CSF chemical levels.
11. Suggest tests on CSF to diagnose central nervous system disorders (meningitis, hemorrhage, etc.)
12. Differentiate between uncompromised and compromised CSF results (hemorrhage vs. trauma tap, side effects created by test procedures and interventions)
13. Use chemistry test results to evaluate the integrity of the blood-brain barrier.
14. Identify cells normally present in CSF.

Additional Tests –

- Occult Blood
- Urine Pregnancy Test

1. List the types of body fluids that are commonly collected for medical laboratory analyses
2. Describe the composition, formation and functions of selected body fluids.
3. Discuss evaluation of body fluid specimens to determine suitability for test(s) requested.
4. Evaluate body fluid specimens for acceptability based on labeling, appropriate volume, collection, handling and storage requirements.
5. Discuss the types of analyses performed on commonly collected body fluids
6. Interpret laboratory findings performed on commonly collected body fluids.
7. Correlate clinical conditions associated with the laboratory findings performed on commonly collected body fluids.
8. Practice
 - Preparation of simulated body fluid (CSF) for cell counts using a hemocytometer
 - Preparation of simulated samples for microscopic examination (wet prep mount)
9. Perform
 - Cell counts using a hemocytometer for simulated CSF
 - Calculations and reporting requirements for cell counts using a hemocytometer.
 - Testing for occult blood
 - Urine pregnancy testing
 - Microscopic examination of simulated wet prep
 - Microscopic examination of KOH prep for fungal elements

15. Explain the pathophysiology resulting in abnormal cellular constituents in CSF.
16. Suggest appropriate microbiology procedures for the detection of microorganisms in CSF.
17. Explain the use of immunologic procedures in diagnosing central nervous system disorders.
18. Interpret CSF analysis results.
19. Correlate CSF analysis results to possible etiologies for central nervous system disorders.

Week
12

Serous Fluid – Chapter 13

1. Define serous body fluids.
2. List the various serous body fluids and correlate to body cavity from which they are obtained.
3. Explain the formation of effusions.
4. Describe body fluid collection procedures and the risk involved during the procedure.
5. Differentiate between transudates and exudates using laboratory results.
6. Differentiate between chylous and pseudo-chylous effusions.
7. List causes of various effusions.
8. Select appropriate laboratory tests for the body fluid being tested.
9. Describe the appearance of normal and abnormal body fluids.
10. Compare and contrast the morphology of cells seen in body fluids.
11. Interpret laboratory results in the analysis of body fluids.

Synovial Fluid – Chapter 14

1. Define synovial.
2. Describe the formation and function of synovial fluid.
3. Explain the collection and handling of synovial fluid.
4. Describe the appearance of normal and abnormal synovial fluids.
5. Correlate the appearance of synovial fluid and possible cause.
6. Describe tests for synovial fluid analysis.
7. Describe cells seen in synovial fluid.
8. Interpret laboratory tests on synovial fluid.
9. Suggest further testing for synovial fluid, based on preliminary results.
10. Classify joint diseases into their recognized categories.

Week
13

Semen – Chapter 16

1. Name the organs involved in the production of semen and explain the involvement of each.
2. Explain the process of spermatogenesis.
3. Explain the proper collection and specimen handling of semen samples.
4. Describe procedures for macroscopic and microscopic analysis of semen.
5. Identify normal and abnormal values for tests comprising a routine semen analysis.
6. Correlate results of semen analysis tests.
7. Identify and describe normal and abnormal spermatozoa morphologies.
8. Identify and describe various sperm motilities.
9. Identify and describe the appearance of viable and nonviable spermatozoa.

Body Fluids –

- Other Specimen Collection/ Handling/ Processing
- Manual Cell Counts
(see week 11 objectives)

Body Fluids –

- Other Specimen Collection/ Handling/ Processing
- Manual Cell Counts
(see week 11 objectives)

10. Classify semen using parameters of count, motility, and morphology.
11. Suggest confirmatory tests for suspected infertility.
12. Explain how confirmatory tests for infertility are performed.
13. Interpret confirmatory infertility tests.
14. Discuss the clinical significance of other cells that may be found in semen besides sperm.
15. Describe types of specimens for which sperm detection may be requested.
16. Suggest appropriate laboratory tests to detect the presence of sperm.

Amniotic Fluid – Chapter 17

1. Describe the production and components of amniotic fluid.
2. Explain the procedure and reasons for performing amniocentesis.
3. Define terminology associated with variation in amniotic fluid volume.
4. Discuss how to differentiate amniotic fluid from maternal urine.
5. Describe the testing available for genetic and congenital abnormalities.
6. Explain the disease process of hemolytic disease of the newborn.
7. Summarize testing available to detect hemolytic disease of the newborn.
8. Compare and contrast the amniotic fluid testing available for fetal lung maturity.
9. Discuss the risks for the fetus in preterm delivery and explain assessment of fetal risk using the Liley graph.

Week
14

Gastric Fluid and Fecal Analysis – Chapter 15

1. Describe gastrointestinal tract physiology and fecal formation.
2. Explain mechanisms of diarrhea, including its relationship to reabsorption of intestinal water and hypermotility.
3. Compare disorders of the gastrointestinal tract.
4. Describe collection procedures for gastric fluid and fecal samples.
5. Describe the appearance of normal and abnormal gastric fluid and feces.
6. Describe laboratory testing for gastrointestinal tract disorders: enzymes, fecal carbohydrates, fecal fat, occult blood.
7. Interpret laboratory findings in various gastrointestinal tract disorders.

Vaginal Secretions - Chapter 18

1. Explain the procedure collection and handling of vaginal secretion specimens.
2. Discuss the origin of substances present in amniotic fluid used in the diagnosing of rupture of fetal membrane (ROM).
3. Describe tests for detecting amniotic fluid in vaginal secretions.
4. Differentiate among various forms of vaginitis.
5. Describe laboratory tests for detection of atrophic vaginitis, desquamative inflammatory vaginitis, bacterial vaginitis, bacterial vaginitis, trichomoniasis, and candidiasis.

Body Fluids –

- Other Specimen Collection/ Handling/ Processing
 - KOH/ Wet Preps /Fungal Preps
- (see week 11 objectives)

Review for Final Practical

6. Summarize laboratory findings in normal vaginal secretions, atrophic vaginitis, desquamative inflammatory vaginitis, bacterial vaginosis, trichomoniasis, and candidiasis.
7. Recognize sources of error when performing laboratory testing of vaginal secretions.

Week
15

Miscellaneous Urine and Body Fluids Tests –
Chapter 19

Final Lab Practical

1. Explain what is detected in a pregnancy test and what may affect test results.
2. Explain the importance of testing for urine eosinophils.
3. Describe the collection of bronchial washings and the bronchoalveolar lavage.
4. Describe normal and abnormal findings for tests performed on bronchial specimens.
5. Describe methods for detection and identification of various microorganisms found in bronchial specimens.
6. Describe methods for testing of middle ear effusions.
7. Describe the procedure for collection of vitreous fluid.
8. Suggest testing that may be performed on vitreous fluid.
9. Suggest reasons for body fluids may be tested.

Review

Exam Week Final Exam

- **There will be chapter or lab announced and/ or unannounced quizzes**
- **This timeline is tentative and subject to change**
- **Study guides/ questions are provided at the discretion of the instructor**
- **The final exam is cumulative and may include some questions from past quizzes and exams, as well as questions on new material**

Note to Instructors