MLT-1000: INTRODUCTION TO MEDICAL LABORATORY TECHNOLOGY

Cuyahoga Community College

Viewing: MLT-1000 : Introduction to Medical Laboratory Technology

Board of Trustees:
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Subject Code
MLT - Medical Laboratory Technology

Course Number:
1000

Title:
Introduction to Medical Laboratory Technology

Catalog Description:
This introduction to Medical Laboratory Technology provides an overview of the profession, safety, blood collection and processing, code of ethics, basic clinical laboratory equipment and instrumentation, basic lab math, quality control and assurance.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
MATH-0955 Beginning Algebra, or qualified Math placement, and departmental approval.

Outcomes

Course Outcome(s):
Discuss the field of clinical laboratory medicine.

Objective(s):
1. Discuss the different careers available in the profession of clinical laboratory science.
2. Identify all educational and competency requirements for laboratory personnel.
3. Identify the major routine tests or services performed by areas of the clinical lab where MLTs may be employed: Chemistry, Hematology, Immunology/serology, Blood bank, Urinalysis and Body Fluids, Microbiology/mycology/virology/ parasitology, Molecular studies/flow cytometry, Quality Control, Information technology, Management/Education.
4. Compare and contrast the various sites for lab testing: central lab, rapid response lab, point of care testing (POCT), Physician's office lab, (POL) and reference lab.

Course Outcome(s):
Demonstrate awareness of laboratory hazard prevention, safety issues, safety equipment and infection control.

Objective(s):
1. Define the term Standard (Universal) Precaution and explain proper applications in the healthcare setting to prevent against HIV/ AIDS and Hepatitis B (and other subgroups) transmission.

2. Examine the general safety regulations governing the clinical laboratory, including components of the OSHA-mandated plans for chemical hygiene and bloodborne pathogens in order to demonstrate compliance.
3. Create a safety checklist that identifies key elements of the following categories of hazards: biohazard, fire, chemical, electrical.

Course Outcome(s):

Describe medical-legal and ethical issues related to the profession.

Objective(s):

1. Identify the major components of a Code of Medical Ethics and apply selected situations in Clinical Laboratory Science.
2. Explain the Health Insurance Portability and Accountability Act (HIPAA) and its applicability, compliance and penalties for violations.
3. Define protected health information (PHI).
4. Explain HIPAA privacy standards.
5. Identify the major components of the law and apply in case studies.
6. Define informed consent and detail consequences of not obtaining it.
7. Explain the Chain of Custody.

Course Outcome(s):

Demonstrate the ability to accurately calculate, measure and prepare laboratory reagents, controls and dilutions using appropriate glassware.

Objective(s):

1. Recall laboratory units of measurement and perform conversions.
2. Define the following terms: reagent, standard, reference, control, analyte, calibrator, lyophilized, working vs. stock reagents, and q.s.,(quantity sufficient).
3. Calculate the amount of diluent and stock reagent to prepare a given solution or dilution; calculate concentration.
4. Discuss the proper way to prepare/handle a 2-part reagent, lyophilized product, quantitative transfer.
5. Prepare and label all reagents correctly to include all pertinent information on the label.
6. Differentiate between Type I and Type II water and select the proper application.
7. Calculate amount of solute/solvent needed to prepare Molar(M), Normal(N) and Percent (w/w, w/v, v/v) solutions.
8. Determine the proper class of glassware to use for given applications.
9. Demonstrate the ability to accurately use, clean and store volumetric glassware.
10. Demonstrate the ability to properly use to deliver (TD), to contain (TC), blow out, and automatic pipettes.

Course Outcome(s):

Demonstrate the ability to use basic clinical laboratory equipment and instrumentation.

Objective(s):

1. Calculate relative centrifugal force (RCF) for a laboratory centrifuge.
2. Demonstrate proper use in loading, balancing, calibration and maintenance.
3. Identify the working parts of a microscope and state the functions of each part.
4. Demonstrate proper usage of microscope as assessed by instructor.
5. Demonstrate the correct technique in the use of the analytical balance including calibration.
6. Demonstrate proper use of Point of Care Instrumentation and QC; correctly interpret QC and troubleshoot.

Course Outcome(s):

Demonstrate the knowledge of principles of photometry and instruments

Objective(s):

1. Differentiate a spectrophotometer from a colorimeter by diagramming the parts of each.
2. Describe the principles of reflectance photometry and its applications.
3. Describe the characteristics of light and its use in photometry.
4. State the wavelength ranges for visible, infrared, and ultraviolet.
5. Explain quality assurance for spectrophotometers.
6. Define Beer's law and its application, applying calculations and describing the affects of variations in variables.
7. Compare and contrast absorbance to transmittance.

8. Construct and read off of a standard curve using absorbance and concentration data.
9. Determine if a plot is linear or non-linear.
10. Indicate situations when Beer's law is not observed and state why.
11. Explain proper selection of standard concentrations.
12. Define water blank, reagent blank, patient blank and standard.
13. Analyze results, then determine when the unknown requires a dilution, and calculate properly.

Course Outcome(s):

Demonstrate an understanding of quality assurance and quality control in a clinical laboratory.

Objective(s):

1. Define quality control and quality assurance, stating examples of each.
2. Define accuracy and precision, stating measures of each.
3. Demonstrate the ability to calculate the mean (X), standard deviation (SD) and coefficient of variation (CV) for a set of data.
4. Diagram a Gaussian distribution, indicating the % of values at +/- 1, 2, & 3 SD.
5. Explain "95% confidence limits".
6. Recognize and state the causes of shifts and trends.
7. Explain the difference between systematic and random errors, and give examples of each.
8. Describe what factors affect quality control values to cause: pre-analytical error, analytical error, and post-analystical error.
9. Recommend corrective actions based on assessment of QC data.
10. Construct a Levy-Jennings chart with proper labeling and limits from given data.
11. State the basic rules and corrective actions based on Westgard Rules.
12. Demonstrate the ability to identify an out of control situation by analyzing and interpreting data.
13. Describe the protocol for obtaining QC ranges for new controls.
14. Differentiate between a control and a standard.
15. Define calibration.
16. Differentiate between unassayed and assayed controls.

Course Outcome(s):

Discuss governmental and voluntary regulation pertaining to the clinical laboratory.

Objective(s):

1. Explain the differences between the terms licensure, certification, registration and accreditation.
2. Describe the different governing groups and agencies involved in the profession of clinical laboratory science.
3. Identify the organizations associated with governance and certification of the profession, describe what they are and their enforcement authority where applicable: American Society for Clinical Laboratory Science(ASCLS)/National Certification Agency (NCA), American Society for Clinical Pathology (ASCP)/Board of Certification (BOC), Medical Technologist (MT)/Clinical Laboratotry Scientist (CLS), Medical Laboratory Technician (MLT)/Clinical Laboratory Technician (CLT), National Accreditation Agency for Clinical Laboratory Science (NAACLS), Joint Commission on Accreditation of Healthcare Organizations (JCAHO), College of American pathologists (CAP), Clinical Laboratory Improvement Act (CLIA).

Course Outcome(s):

Demonstrate correct application of blood collection techniques and processing, including quality assurance and control.

Objective(s):

1. Demonstrate understanding of the importance of specimen collection and specimen integrity in the delivery of patient care.
2. Demonstrate knowledge of collection equipment, various types of additives which are used, and special precautions which are necessary and subsances that can interfere in clinical analysis of blood constituents.
3. Identify the various types of additivies used in blood collection, and explain the reasons for their use.
4. Cite the appropriate order of draw when additive tubes are used.
5. Demonstrate understanding of requisitioning, specimen transport, specimen processing and storage.
6. Explain the proper procedures for processing whole blood specimens when serum or plasma is needed.
7. Describe the proper procedure for obtaining quality specimens for the lab (venous, arterial and capillary).
8. Perform a successful venipuncture with evacuated tube, capillary collection and syringe draw.
9. Discuss that practicing arterial puncture is illegal for a phlebotomist in the State of Ohio and articulate that the student will at no time attempt to perform an arterial puncture.

10. Name and explain frequent causes of phlebotomy complications. Describe signs and symptoms of physical problems that may occur during blood collection and course of action that may be taken.
11. Identify policies and procedures used in the clinical laboratory to assure quality in the obtaining of blood specimens: perform quality control procedures, record quality control results, identify and report control results that do not meet pre-determined criteria and take appropriate action.
12. Describe the potential clerical, technical, pre and post analytical errors that may occur during specimen processing, collection, labeling, transporting.
13. Describe and follow the criteria for specimens and test results that will be used as legal evidence, i.e. paternity testing, chain of custody, blood alcohol levels, etc.

Methods of Evaluation:

1. Tests
2. Quizzes
3. Mid Term Exam
4. Final Exam
5. Laboratory Exercises
6. Laboratory Practical Exams
7. Problems Solving Exercises
8. Instrumentation Project

Course Content Outline:

1. Introduction
   a. Departments within a laboratory
   b. Laboratory sites
   c. Laboratory personnel
   d. Laboratory regulations
   e. Laboratory governance
   f. Laboratory organizations
2. Safety
   a. Hazard types
   b. Infection control and chemical hygiene
   c. Hazard prevention and response
   d. Safety equipment and personal protective equipment
3. Medical-legal Issues
   a. Code of Medical Ethics
   b. HIPAA
   c. Informed consent
4. Reagent Preparation
   a. Units of measurement
   b. Solution Preparation
   c. Water
   d. Concentration
5. Glassware
   a. Identification
   b. Uses
   c. Cleaning
6. Pipettes and Pipetting
   a. Identification
   b. Uses
   c. Calibration
7. Basic Laboratory Equipment
   a. Centrifuge
      i. Swinging bucket
      ii. Calibration
   b. Microscopes
      i. Identification of parts and their Functions
      ii. Use
      iii. Care and maintenance

   c. Analytical Balance
      i. Use
      ii. Calibration
   d. Point of Care Instrumentation
      i. Use
      ii. Calibration
      iii. Troubleshooting
8. Photometry
   a. Characteristics of light
   b. Instrumentation parts and functions
   c. Beer's law
      i. Definition
      ii. Application
      iii. Variables and troubleshooting
   d. Standard curves
9. Quality Assurance
   a. Factors Affecting QC
      i. Pre-analytical
      ii. Analytical
      iii. Post-analytical
   b. Controls and standards
   c. Standard deviation
      i. Accuracy
      ii. Precision
      iii. Reliability
      iv. Gaussian Curve
      v. SD and CV
      vi. Westgard Rules
10. Blood Collection
   a. Phlebotomist role
   b. Collection equipment
      i. Tube color, type
      ii. Additives/anticoagulants
      iii. Safety devices
      iv. Syringes and blood cultures
   c. Sample collection
      i. Perform venipuncture, capillary, syringe draws
      ii. Asepsis
      iii. Adult, geriatric, pediatric
      iv. Arterial avoidance
      v. Special collections/handling
   d. Complications and corrective actions
   e. Specimen handling
      i. Requisitioning
      ii. Processing
         1. Centrifugation
         2. Special handling
         3. Storage
         4. Transport
         5. Medical-legal issues
   f. Quality assurance

Resources

Turgeon, Mary Louise. *Linne & Ringsrud's Clinical Laboratory Science: Concepts, Procedures, and Clinical Applications*. 8th ed. St. Louis, MO: Elsevier, 2021.

Doucette, Lorraine. *Mathematics for the Clinical Laboratory*. 4th ed. St. Louis, MO: Elsevier, 2021.

McCall, Ruth. *Phlebotomy Essentials, Enhanced Edition*. 7th ed. Burlington, MA: Jones & Bartlett Learning, 2020.

Garza, Diana and Becan-McBride, Kathleen. *Phlebotomy Handbook: Blood Specimen Collection from Basic to Advanced*. 10th ed. NY, NY: Pearson, 2019.

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